MPANY

LICO SAN DIEGO

MODEL 8420

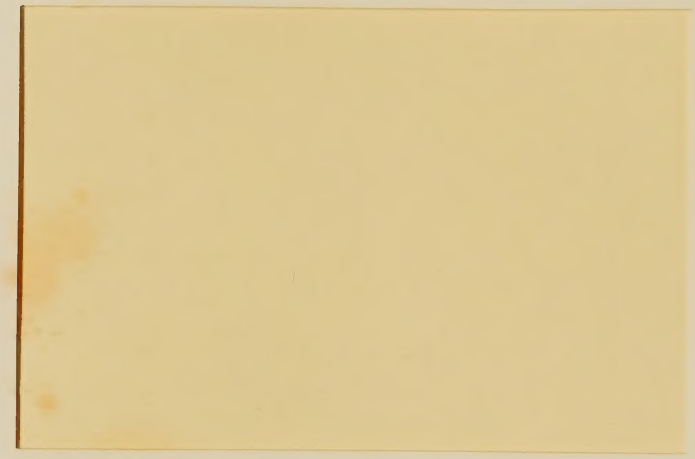
DIGITAL

MULTIMETER/ COUNTER

CALICO

CALIFORNIA INSTRUMENTS COMPANY
a division of AIKEN INDUSTRIES, INC.

5150 CONVOY STREET | SAN DIEGO, CA 92111 714–279–8620 CABLE: CALICO SAN DIEGO



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4th Printing
May, 1972
CALICO

INSTRUCTION MANUAL

MODEL 8420

DIGITAL

MULTIMETER/ COUNTER

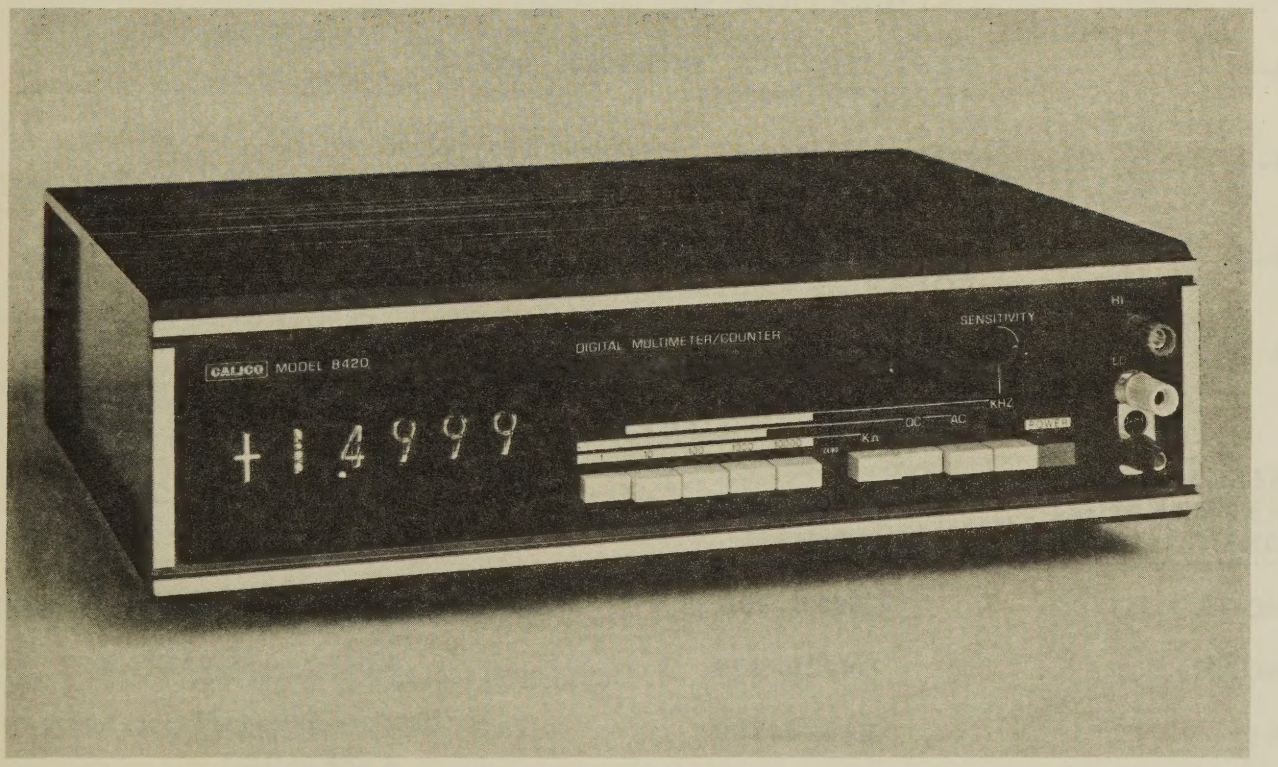

FIGURE 1-1

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ASSEMBLY REFERENCE DESIGNATOR	DRAWING NUMBER	TITLE
NONE	C8420-900	OUTLINE DRAWING
NONE	D8420-400	FINAL ASSEMBLY
A1	E8420-700	MULTIMETER P.C.B. ASSEMBLY
A1	E8420-070 (2 sheets)	UNIT SCHEMATIC

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CODE LIST OF MANUFACTURERS

SPECIFICATIONS

	DC	AC	KΩ	KHz
FULL SCALE	1, 10, 100, 1000V	1, 10, 100, 1000V	1, 10, 100, 1000, 10000KΩ	10, 100, 1000, 10000 KHz
ACCURACY for 90 days at 25°C ±5°C after 15 minutes warm-up	0.01% of reading ± 1 digit	0.1% of reading ± 3 digits from 60 Hz to 10 KHz 0.5% or reading ± 10 digits from 30 Hz to 50 KHz ±100 digits from 50KHz to 100 KHz	0.02% of reading ± 1 digit on 1 KΩ through 100 KΩ ranges 0.1% of reading ± 1 digit on 1 MΩ and 10 MΩ ranges	0.02% of reading ±1 digit from 50 Hz to 1MHz 0.05% of reading ± 2 digits from 50Hz to 10MHz
RESOLUTION in % of full scale	0.01%	0.01% at 1KHz	0.01%	0.01% above 50 Hz
INPUT IMPEDANCE	10 Meghoms	1 Megohm in parallel with 50 pf nominal.	———	500 Kilohms in parallel with 75 pf nominal
NORMAL MODE REJECTION	40 db at 60 Hz ± .1%	———	———	———
COMMON MODE REJECTION	100 db DC to 60 Hz 80db DC with 100Ω unbal	60 db at 60 Hz with no unbalance	———	———
OVERRANGE	50% of full scale or 1000 VDC maximum, whichever is less.	50% of full scale or 500 VAC maximum, whichever is less	50% of full scale	50% of full scale or 10 MHz maximum, whichever is less.
OVERLOAD CAPABILITY	10,000 % of full scale but not to exceed 1000 VDC	10,000% of full scale but not to exceed 500 VRMS	200 VDC or peak AC	250 VRMS maximum
NOMINAL SOURCE CURRENT	———	———	1KΩ 6.2 milliamperes 10KΩ 620 microamperes 100KΩ 62 microamperes 1MΩ 6.2 microamperes 10MΩ 620 nanoamperes	———
READING RATE	3 per second	3 per second	3 per second	1 per 2 seconds
SENSITIVITY	———	———	———	0.1 VRMS from 50Hz to 1MHz 0.25 VRMS from 1 MHz to 10 MHz
AVERAGE TEMPERATURE COEFFIEIENT from 0°C to 55°C	± 0.002% of full scale per degree C	± 0.01% of full scale per degree C	± 0.005% of full scale per degree C	± 0.005% of full scale per degree C

OPERATING TEMPERATURE RANGE: 0°C to +55°C

STORAGE TEMPERATURE RANGE: -20°C to +85°C

MAXIMUM COMMON MODE VOLTAGE: 500 VDC or peak AC

POWER: 18 watts maximum, 115 VAC or 230 VAC ± 10%, 50 to 400 Hz

SIZE: 3-1/2"H x 13-1/4"W x 9-5/8"D

NET WEIGHT: 11 pounds

SHIPPING WEIGHT: 15 pounds

All specifications apply when tested in accordance with standard CALICO test procedures.

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GENERAL DESCRIPTION

1.1 INTRODUCTION

This instruction manual contains information on the installation, operation, calibration and maintenance of the CALICO Model 8420 Digital Multimeter/Counter. A photograph of the instrument is shown in figure 1-1.

1.2 DESCRIPTION

The CALICO Model 8420 Digital Multimeter/Counter measures DC voltage, AC voltage, resistance and frequency.

The ranges and functions are selected by push buttons located on the front panel.

The CALICO Model 8420 Digital Multimeter/Counter operates from 115 volts AC or 230 volts AC from 50 to 400 Hz, and consumes less than 18 watts.

1.3 EQUIPMENT SUPPLIED

The unit is shipped with the following:
1 - Belden #17258 power cord

1 - CALICO 8420 Instruction Manual

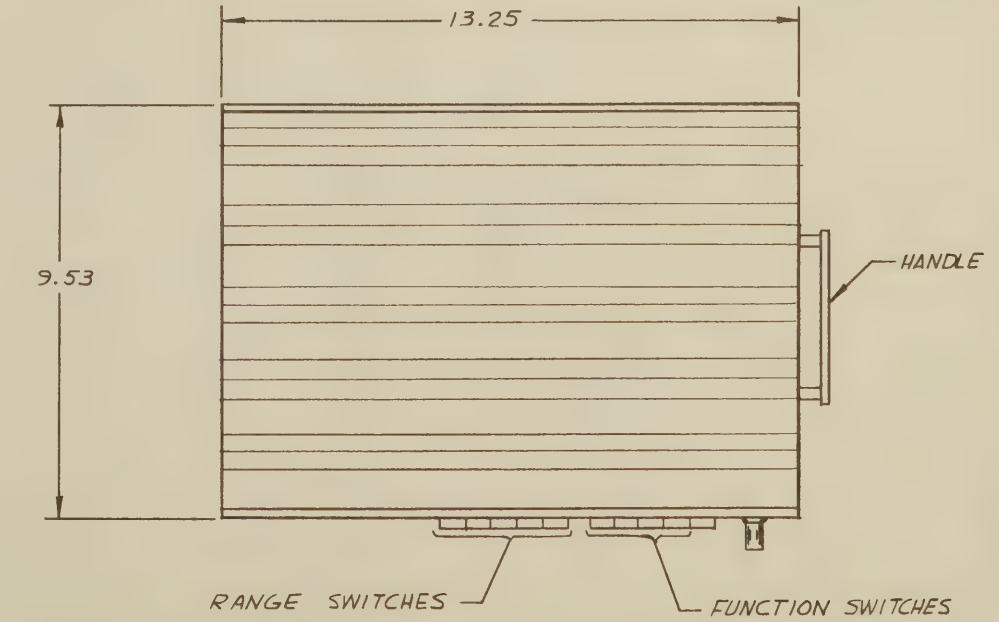
1.4 ACESSORY EQUIPMENT

The following accessories are available for use with the Model 8420 Digital Multimeter/Counter.

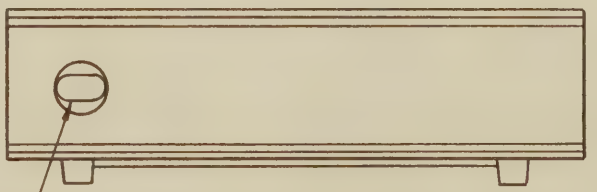
1.4.1 Option R Rack Mount. The CALICO Model 8420 may be purchased in a rackmount case by adding "Option R" to the Model number.

1.4.2 The 8420-800 Input Cable. This cable mates with the front panel binding posts on the 8420 Digital Multimeter/Counter. The other end contains banana jacks for use with aligator clips.

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



FRONT VIEW
MODEL 8420



REAR VIEW

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
REQD PER ASSY							

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

DIM IN INCHES
TOLERANCES
XXX = .010
.XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

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TITLE: OUTLINE DRAWING, DIGITAL MULTIMETER/ COUNTER

MODEL 8420

RELEASE			
CHECKER		11/9/71	PURCHASING
DESIGN			PROJ ENGR
DRFTSMN	MARTIN M 11/9/71		CHF ENGR

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.
CODE IDENT 16067
DWG NO. C8420-900
REV -
SCALE 1/2
SHEET 1 OF 1

C8420-900

CALICO F-102

WARNING

HIGH VOLTAGE (180 VAC)

This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with all input and output connections.

2.1 UNPACKING

This instrument is shipped in a cardboard container with a protective inner packing. Do not destroy the packing container until the unit has been inspected for possible damage in shipment.

2.2 POWER REQUIREMENTS

This unit operates from 115 VAC or 230 VAC ±10% at 50 to 400 Hz. The power consumption is less than 18 watts.

2.3 OPERATING CONTROLS

2.3.1 FRONT PANEL CONTROLS

2.3.1.1 RANGE SWITCH

The range switch is a five station, interlock, push button switch located in the middle of the front panel. The five ranges are 1, 10, 100, 1000, and 10,000. These ranges are direct multipliers for the units of measure used on the function switch, i.e., 1 VDC full scale, 1 KΩ full scale, etc.

2.3.1.2 FUNCTION SWITCH

The function switch is a four station, interlock, push button switch located on the right side of the front panel. These functions are DC voltage, AC voltage, resistance and frequency.

2.3.1.3 SENSITIVITY CONTROL

The sensitivity control is a variable attenuator located directly above the KHz function button. This control attenuates the incoming signal prior to processing by the frequency counter.

2.3.1.4 FRONT PANEL ZERO CONTROL

The front panel zero control is used to zero the preamplifier. The preamplifier is used on all DC and KΩ ranges.

2.3.1.5 POWER SWITCH

The front panel power switch is a push for ON: push for OFF type switch. It is located at the right end of the function switch.

2.3.2 INTERNAL CONTROLS

2.3.2.1 115 - 230 VOLT SWITCH

The 115 -230 volt slide switch is located near the right rear corner of thr printed circuit board. This switch allows the instrument to be operated from 115VAC or 230 VAC ± 10%. In order to operate the instrument from 115 volts AC, switch to the 115 position and install a 0.25 ampere slow blow fuse. To operate the instrument from 230 VAC, slide the 115 -230 switch to the 230 position and install a 0.125 ampere slow blow fuse.

2.4 ACCEPTANCE TEST PROCEDURE

Inspect the unit for any possible shipping damage immediately upon receipt. If any damage is evident, notify the carrier, DO NOT return the instrument to the factory without prior approval. If the unit appears to be in good condition, perform the following.

a) Connect a wattmeter between the AC power input to the instrument and the AC line.

NOTE

The Model 8420 Digital Multimeter/ Counter is shipped from the factory ready to operate from 115 VAC. For 230 VAC operation consult section 2.3.2.1 of this instruction manual.

b) Turn the unit on and check that the power does not exceed 18 watts. Allow 15 minutes for the unit to warm up.

c) Short the inputs together. Select the DC function and the 1 range. Check that the display reads all zeros. If the display does not read all zeros adjust the front panel zero control.'

d) Using a COHU Model 351 precision DC standard, or equivalent, connect the Model 8420 Digital Mulimeter/Counter input to the output of the DC standard. Adjust the DC standard to 1.0000 volt DC ± .003%. The display should read 1.0000 ± 2 digits.

e) Select the AC function and the 1 range. Connect the Model 8420 Digital Multimeter/Counter input to the output of a H.P. 745AC calibrator or equivalent. Adjust the AC calibrator output to 1.0000 volt rms ±0.02% at 1KHz. The display should read 1.0000 ± 13 digits.

f) Select the KΩ function and the 1 range. Connect the input leads to a precision 1000 ohm ± 0.005% resistor. The display should read 1.0000 ± 3 digits.

If further evaluation is required, see section 4.0 of this instruction manual.

2.5 INSTALLATION

The CALICO Model 8420 Multimeter/Counter may be bench mounted or rack mounted. To rack mount this instrument, add OPTION R to the model number at the time of purchase.

Although no cooling fans are required, the unit should be installed so that the normal flow of air is not obstructed. Care should also be taken not to install the unit in areas where excessive heat is produced by other equipment.

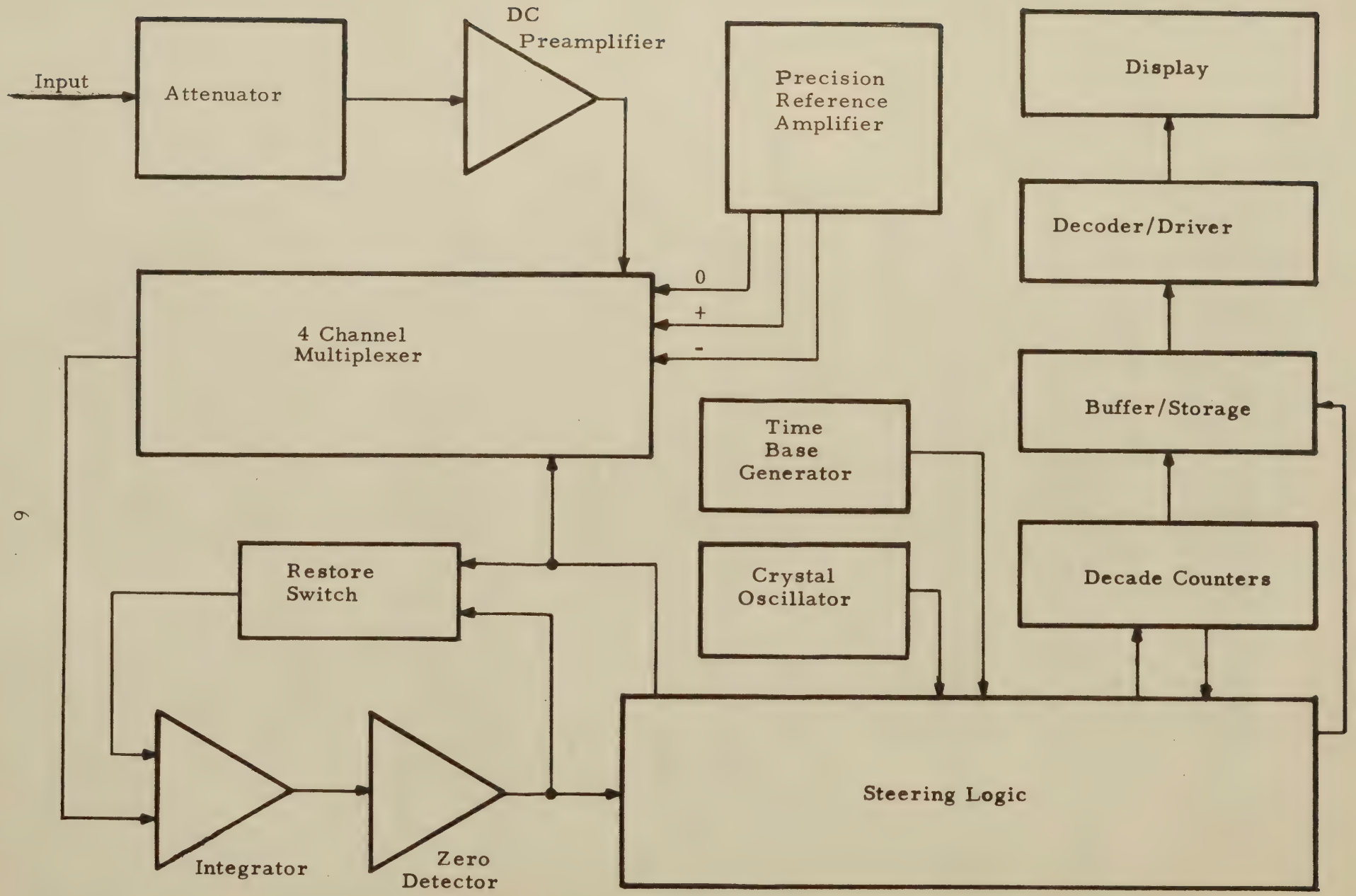


FIGURE 3-1 Functional Block Diagram For Model 8420 Digital Multimeter

THEORY OF OPERATION

3.1 GENERAL

The CALICO Model 8420 Digital Multimeter/Counter is a precision digital voltmeter that measures DC voltage. A block diagram that illustrates the theory of operation is shown in Figure 3-1. The measurement of AC volts and ohms is accomplished by first converting these inputs to a DC voltage then measuring the DC voltage. The measurement of frequency is accomplished by counting the unknown input frequency with the decade counters for a fixed period of time.

The analog to digital conversion process is accomplished by a three step integrator, as shown in figure 3-2. The first step is the restore mode. In this mode one input to the integrator is connected to ground and a feedback signal is applied to the other input. This automatically adjusts out any offset voltage in the integrator.. The second step begins with the receipt of an encode start pulse from the time base generator. This resets the decade counters to all zeros and opens the gate to the crystal oscillator. At this same time the input to the integrator is connected to the analog input signal. The output of the crystal oscillator continues to feed the decade counters until they count through 9999 and back to 0000. At this point the analog voltage from the preamplifier is removed from the integrator input and the proper reference voltage from the reference amplifier is applied to the integrator input throught the multiplexer. This reference voltage is selected to be of the opposite polarity to the analog input voltage. This drives the output of the integrator back toward zero. As the output of the integrator passes through zero, the output of the zero detector changes state. This closes the gate to the crystal oscillator and transfers the data accumulated in the decade counters into the storage register for display. At this same time the instrument is returned to the restore mode.

3.2 DETAILED CIRCUIT DESCRIPTION

The schematic diagram for all of the electronics in the CALICO Model 8420 Digital Multimeter/Counter is contained in drawing numbdr E8420-070 which is divided into two sheets. The digital logic used in this instrument is of the TTL type. The "0" state is defined to be between 0 and +.4 volts DC and the "1" state is defined to be between +2.4 and +5 volts DC. Figure 3-3 illustrates a truth table for the four logic gate functions which are used in this instrument.

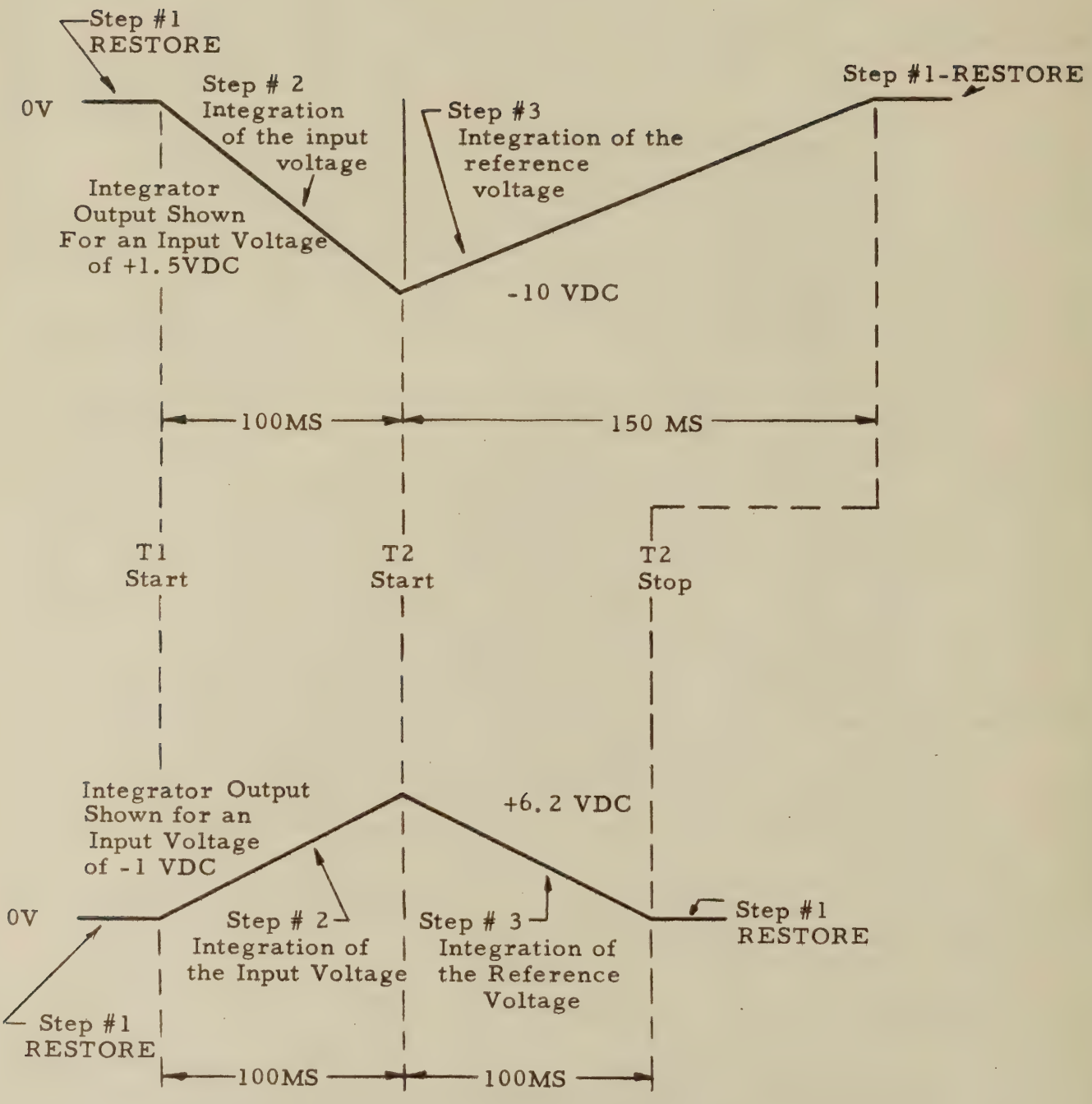
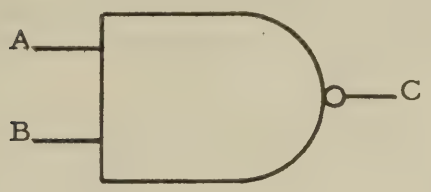


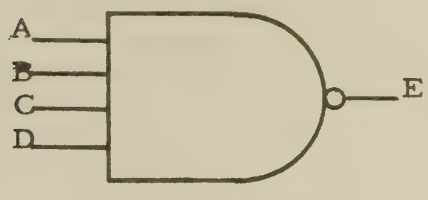
Figure 3-2 Timing Diagram for
Model 8420 Digital Multimeter/Counter

2 INPUT NAND GATE



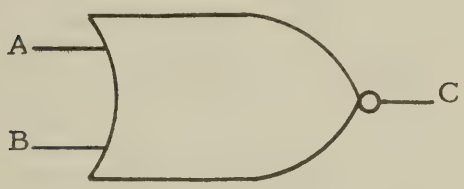
A	B	C
0	0	1
1	0	1
0	1	1
1	1	0

4 INPUT NAND GATE



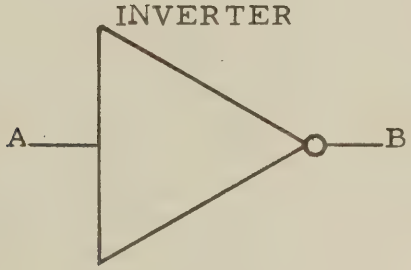
A	B	C	D	E
0	0	0	0	1
1	0	0	0	1
1	1	0	0	1
1	1	1	0	1
1	1	1	1	0

2 INPUT NOR GATE



A	B	C
0	0	1
1	0	0
0	1	0
1	1	0

INVERTER



A	B
0	1
1	0

FIGURE 3-3 TRUTH TABLE FOR LOGIC GATES USED IN MODEL 8420 DIGITAL MULTIMETER/ COUNTER

3.2.1 ANALOG TO DIGITAL CONVERTER

The Model 8420 Digital Multimeter/Counter uses a three step integration process for comparing an unknown input voltage to a precision internal reference voltage.

Step one of this process is the RESTORE mode. In this mode a "1" level is present at pin 3 of IC37. This drives the output of IC37, pin 6, to +15 volts. This, in turn, back biases CR18 and CR21, causing Q14 and Q16 to turn "on". Transistor Q14 grounds the input to the integrator, IC34 and Q10, through R59 and R60. Transistor Q16 closes a feedback loop from the zero detector, IC31 and Q15, back to the non-inverting input of the integrator, Q10 gate 2. This feedback loop removes any offset voltage that exists in the integrator or zero detector. The instrument will remain in this mode until acted upon by an encode enable pulse.

Step number two begins as the unijunction oscillator, Q4, produces an encode enable pulse. This pulse is fed into a differentiator formed by C12, R19 and Q5. The output of this differentiator, IC5 pin 13, is a negative going pulse 2 microseconds wide. This produces a positive pulse at IC5 pin 12. This pulse is used to reset the decade counters to all zeros. It is also used to set IC30 pins 1 and 4 to the '0' state. This in turn opens the gate on the output of the 1 MHz crystal oscillator, IC27-B. At this same time IC30 pin 10 goes to the "1" state which drives IC38 pin 6 to +15 volts DC. This turns Q13 "on" thus connecting the unknown input voltage to the input of the integrator. For the purpose of this explanation it will be assumed that the instrument is in the DC function and has a + full scale voltage applied on the unknown input. This will cause the integrator output (the junction of R46 and C21) to start ramping negative. Since the DC function was selected this places a "1" at IC4 pin 9 and a "0" at IC4 pin 12. This allows the 100 KHz output from IC26 pin 11 to be fed through to the decade counter input at IC3 pin 14. The unit Will remain in this mode until the decade counters have counted up to 09999. The act of the counters advancing to 10000 starts step 3. Since the unknown input voltage is positive this drives the output of the zero detector, collector of Q 15, to the "1" state. Thus setting IC16 pin 1 to the "1" state and IC16 pin 4 to the "0" state.

Step three begins when IC25 pin 12 goes to the "1" state. This sets IC30 pin 10 to the "0" state and IC30 pin 4 to the "1" state. This drives IC33 pin 13 and IC16 pin 13 to the "0" state, thus holding the polarity data contained in IC16A and B. At the instant the third step begins there is a negative going polarity interogate pulse at IC29 pin 3. If the unknown input voltage is positive this will produce a positive going pulse at IC29 pin 1. This drives the polarity display flip-flop formed by IC29B and C. If the unknown input voltage is negative no pulse will occur.

Since IC29 pins 11 and 12 are in the "0" state this drives IC5 pin 2 to the "0" state. This enables the polarity data contained in IC16A and B to be fed into IC33B and C. This causes a "1" state to occur at IC33 pin 4 which drives IC35 pin 6 to +15 volts DC. This turns Q11 'on' connecting the negative reference voltage to the input of the integrator. This causes the output of the integrator to start ramping back toward zero. As the output of the integrator passes through zero the output of the zero detector, collector of Q15, changes to a "0" state. This drives the output at IC27 pin 13 to the "0"state; which in turn sets IC30 pin 13 to the "0" state. This produces a positive going pulse at IC5 pin 10 which transfers the data accumulated in the decade counters into the storage register for display. At this same time IC30 pin 1 goes to the "1" state which stops the output of the crystal oscillator and drives IC37 pin 6 to +15 volts returning the instrument to the restore mode.

3.2.2 PRECISION REFERENCE AMPLIFIERS

The precision reference amplifier consists of two operational, integrated circuit amplifiers IC28 and IC34. The first amplifier, IC28 has a temperature compesated zener diode in its negative feedback loop, CR11. This produces an output at the cathode of CR11, of +6.2 volts DC. This output is applied to the second amplifier IC34 which is operated as a gain of -1.0 amplifier. This produces an output of -6.2 volts DC at the anode of CR15. This output is applied through R27 to the summing junction of the first amplifier. Since the gain of the second amplifier is -1.0, the current that flows through CR11 is the zener voltage of CR11 divided by the resistance of R27. The amplifiers IC28 and IC34 are unable to provide the full amount of this current and it is supplied through R28 and R47 from the + and - 15 volt DC supplies. The +6.2 and -6.2 volt reference outputs are used to drive two of the four inputs of the multiplexer.

3.2.3 DC PREAMPLIFIER AND ATTENUATOR

The DC preamplifier consists of Q22 and IC42. Dual transistor Q22 is used as a differential source follower, driving the inputs to an integrated circuit amplifier IC42. The DC preamplifier is operated as a potentiometric amplifier with a gain of approximately 6.2. The gain determining feedback resistors are R140, R141, R145 and R149. A tracking ±6 volts DC power supply is used tosupply power to the input transistor Q22. This supply is generated by driving an integrated circuit voltage follower, IC40, from the gain of one feedback point associated with the DC preamplifier. This produces a low impedance voltage source, that tracks the input signal. This output, IC40 pin 6, is used to drive two 6 volt zener diodes CR32 and CR33, thus producing a ± 6 volt DC supply that tracks the input signal.

The input attenuator consists of R78, R80, R81, R89, R91, R100, R101, R109, R110, R111, and R115. This attenuator provides attenuations of 10:1 (R101 ARM), 100:1 (R91 ARM) and 1000:1 (R81 ARM). This attenuator is also used on the KΩ function. Its use, related to the KΩ function, will be explained under section 3.2.5 Ohms to Volts Converter.

3.2.4 AC TO DC CONVERTER

The AC to DC converter consists of Q20, Q21, IC41, IC43, and IC44. It provides an output of -6.2 volts DC at IC43 pin 6 for an input of 1 volt rms at the gate of Q20. Full scale inputs of 10 volts AC, 100 volts AC and 1000 volts AC are fed through AC attenuators to provide 1 volt AC prior to feeding this signal into Q20. Q20 and Q21 form a gain of one amplifier that has a high input inpedance and a low output impedance. Integrated circuit IC41, CR38 and CR39 form an operational rectifier with a differential output. The positive half wave rectified output comes from the cathode of CR39 through R146 into the summing junction of the output amplifier. The negative half wave rectified output comes from the anode of CR38 through R160 into the inverting amplifier IC44. The output of the inverting amplifier at IC44 pin 6, produces a positive half wave output that is 180° out of phase with the positive half wave output at the cathode of CR39. These two signals drive the same summing junction, IC43 pin 2, of the operational output filter, The resulting output of the operational output filter, IC43 pin 6, is a DC level that is proportional to the amplitude of AC input voltage. Capacitor C55 is used to remove the ripple for the output of the AC/DC converter.

3.2.5 OHMS TO VOLTS CONVERTER

A block diagram for the Ohms to Volts Converter is shown in Figure 3-4. This converter consists of, the ohms reference amplifier, IC39 and Q19, and the same attenuator network and preamplifier that is used on the DC volts function. The DC preamplifier is operated as a operational amplifier, with the unknown resistor Rx in the negative feedback loop. The input resistor to this amplifier is formed by the attenuator network. The test current that flows in the unknown resistor is set by, the output voltage of the ohms reference amplifier, divided by the attenuator resistance for the selected range. For example, on the 10 KΩ range, the attenuator resistance is 10KΩ and assume the reference voltage to be 6.200 volts DC, then the test current would be 620.0 microamperes. If the unknown resistance is 10KΩ then the DC preamplifier output voltage at S1-A-9 would be 6.200 volts DC. This would in turn produce a reading of 10.000 in the display.

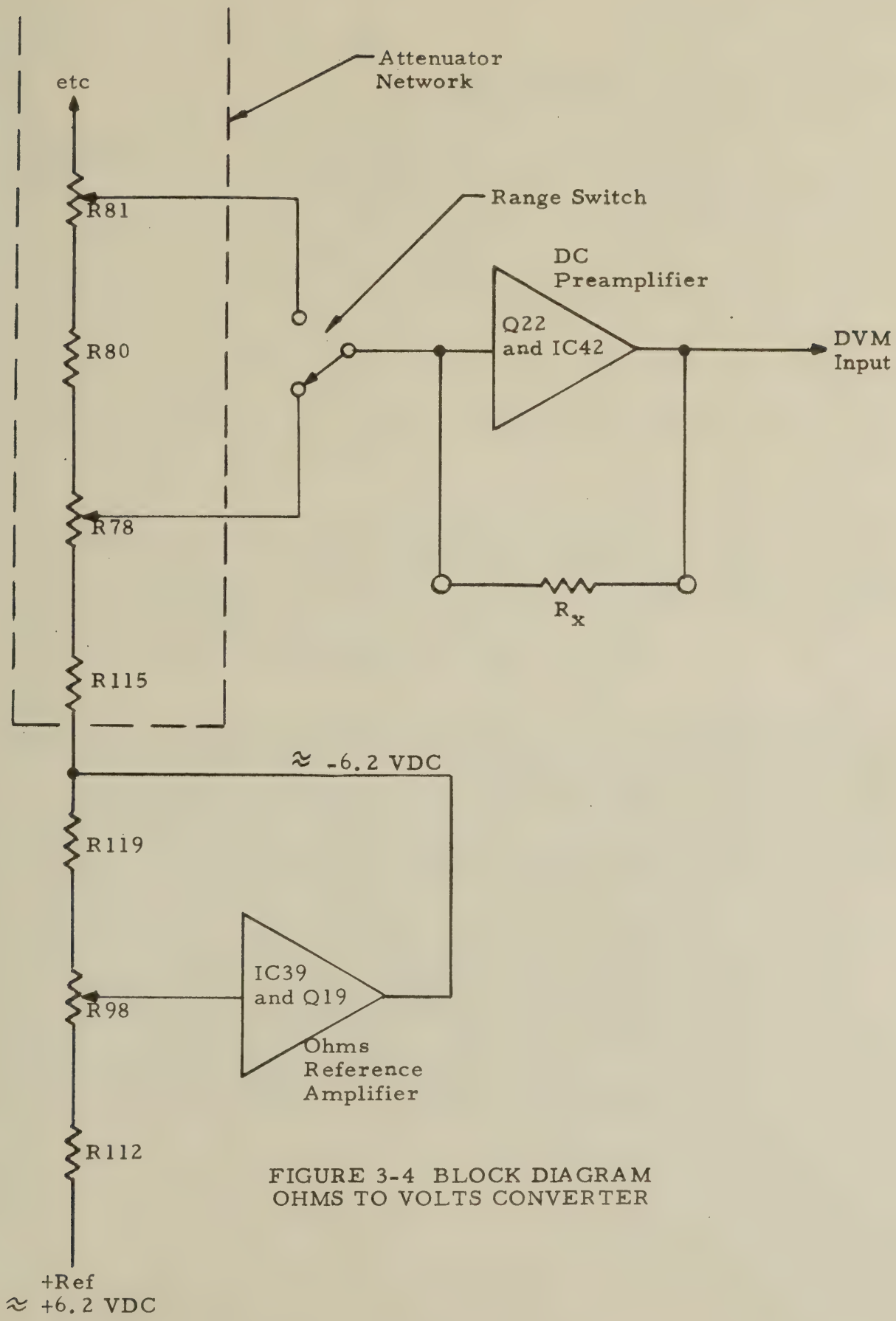


FIGURE 3-4 BLOCK DIAGRAM
OHMS TO VOLTS CONVERTER

3.2.6 FREQUENCY COUNTER

The frequency counter uses the circuitry of the basic analog to digital converter. The crystal oscillator is fed through two divide by 10 counters, IC26 and IC23, to produce a master clock frequency of 10 KHz. The analog input voltage is derived from the precision reference supply, IC28, and is fed through the ohms/frequency reference amplifier, IC39 and Q19. Since the analog input voltage is equal to the reference voltage, the time required to complete steps 2 and 3 of the integration process will be equal. The time of step 2 is set by feeding the 10KHz master clock into the decade counters until they have accumulated 10000 counts. This produces an integration time of one second. Since in this mode step 3 will also equal one second, feeding the unknown input frequency into the decade counters during this time will produce a reading equal to the unknown input frequency.

The unknown frequency input is fed into the front panel sensitivity control. This control is a variable attenuator that provides from 0 to 60db of attenuation. The output of this attenuator is fed into the frequency-input amplifier, Q17 and Q18. This amplifier converts small amplitude sine waves into square waves of a drive level compatible with TTL logic. The output of this amplifier, Q18 pin 14, is fed into a latching amplifier formed by IC15A and B.

The purpose of the latching amplifier is to produce fast rise time square waves that do not contain noise. This is done by feeding the square waves from the input amplifier through R20 into IC15 pin 2, and applying positive feedback from IC15 pin 4 back to IC15 pin 2, through R17. The fast rise time square waves from the latching amplifier output, IC15 pin 4, are fed into a series of three divide by 10 counters, IC7, IC11 and IC18. These counters drive a series of four range selection gates, IC6. Pressing one of the four front panel push button range switches will enable the corresponding range selection gate. For example, pressing the 1000 KHz range button will enable IC6-C. This will produce a division ratio of 100:1 from the input frequency. Thus an unknown input frequency of 1 MHz would be scaled down to 10 KHz and fed into the decade counters during step three, of the conversion process. At the conclusion of step three, the counts accumulated in the decade counters are transferred into the storage register for display.

3.2.7 POWER SUPPLIES

The power transformer has a split primary and may be operated from 115 VAC or 230 VAC ± 10%. (Selectable by the 115-230 switch S2).

Secondary S1 provides 180 volts rms AC ±10% at a current of 0.018 amperes rms. This is half wave rectified by CR1 for the use as the anode supply for the display tubes.

Secondary S2 drives a full wave silicon diode bridge, CR2, CR3, CR4, and CR5. The output of this bridge drives two 250 microfarad capacitors and provides ±25 volts DC ±10% with approximately 1.3 volts peak-to-peak ripple. These voltages are regulated down to ±15 volts DC ±10% with a series type regulator. The +15 volts DC regulator consists of Q2, CR8, and R9. The -15 volts DC regulator consists of Q3, CR9, R11 and R10.

Secondary S3 is a center taped winding that is full wave rectified by two silicon diodes, CR6 and CR7. This rectified output is filtered by a 4000 microfarad capacitor, C7, to provide +8 volts DC ±10% with approximately 1.2 volts peak-to-peak ripple. This output drives an integrated circuit voltage regulator, IC19, which provides an output between +4.75 and +5.25 volts DC.

3.2.8 OVERLOAD INDICATOR

The overload indicator consits of IC45, Q23 and DS7. This indicator illuminates any time the display reads 15000 or higher. The BCD outputs from the thousands and tenthousands storage registers are decoded by IC45, to provide a "1" output for readings of 15000 and higher. The "1" output, at IC45 pin 10, is used to provide base drive to Q23. As Q23 turns "on", its collector curent flows through DS7 causing the light to illuminate.

NOTE

In the FREQUENCY mode it is possible to exceed the 19999 digit capacity of the display. If this should occur the overload indicator will not provide the proper indication.

CALIBRATION AND TEST PROCEDURE

Figure 4-9 shows the location of all internal adjustments required to calibrate the Model 8420 Digital Multimeter/Counter.

WARNING

HIGH VOLTAGE (180 VAC)

This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with all input and output connections.

4.1 TEST EQUIPMENT REQUIRED

a) DC Voltage Standard: Cohu 351 or equivalent
b) AC Voltage Standard: Hp 745 and 746 or equivalent
c) Frequency Counter: Hp 5323A or equivalent
d) Oscillator: Hp 5323A or equivalent
e) Resistance Standards: 1KΩ, 10KΩ, 100KΩ, 1MΩ, and 10MΩ ±0.005%
f) AC Wattmeter: Triplett 661 or equivalent
g) Variac: Superior Electric 216 or equivalent
h) Microammeter: Hp 425 or equivalent
i) Oscilloscope: Tektronix 535 with L preamp or equivalent
j) Frequency standard: Hp 105A or equivalent

4.2 CALIBRATION PROCEDURE

The following calibration procedure may be preformed on a routine basis to insure that the unit remains within specified tolerance. This procedure should always be performed after any repairs are made on the basic accuracy determining circuitry. Before calibrating the unit, apply AC power and allow one hour to permit the internal circuitry to stablize.
This procedure covers the following adjustments:
a) Zero adjustment of A-D converter
b) Zero adjustment of input amplifier
c) Calibration of A-D converter
d) Zero adjustment of AC to DC converter
e) Calibration of AC to DC converter
f) Calibration of ohms converter
g) Calibration of frequency counter

The calibration procedure should be preformed as follows:

4.2.1 Select the DC function and the 1 range. Connect a microammeter to the input terminals, as illustrated in figure 4-1.

Adjust the front panel zero control R130 until the microammeter reads less than 50 picoamperes. Remove the microammeter and short the input terminals, of the Model 8420 Digital Multimeter/Counter, together. Adjust R69 until the display reads ± .0000.

4.2.2 Connect the input to a precision DC voltage standard, as shown in Figure 4-2. Adjust the DC voltage standard to provide a output of -1.0000 volt DC ± 0.003%. Adjust R149 until the display reads -1.0000.

4.2.3 Adjust the DC voltage standard to provide an output of +1.0000 volt DC ± 0.003%. Adjust R42 until the display reads +1.0000.

4.2.4 Select the 10 range and apply an input voltage of +10.000 volts DC ± 0.003%. Adjust R101 until the display reads +10.000.

4.2.5 Select the 100 range and apply an input voltage of +100.00 volts DC 0.003%. Adjust R91 until the display reads +100.00.

4.2.6 Select the 1000 range and apply an input voltage of +1000.00 volts DC ± 0.003%. Adjust R81 until the display reads +1000.00.

4.2.7 Connect the input terminals of the Model 8420 Digital Multimeter/Counter to a resistance standard of 10,000 ohms ± 0.005%, as shown in figure 4-3. Select the 10 range and the KΩ function. Adjust R98 until the display reads 10.000.

4.2.8 Select the 1 range and connect the input of the Multimeter/Counter, to a resistance standard of 1000.0 ohms ± 0.005%. Adjust R78 until the display reads 1.0000.

4.2.9 Select the 10 range and the KHz function. Apply an input of 10000 Hz ± 0.005% at 1 volt rms, as shown in figure 4-4. Adjust R99 until the display reads 10.000.

4.2.10 Select the 1 range and the AC function. Short the input terminals of the Multimeter/Counter together. Adjust the R147 until the display reads .0000.

4.2.11 Connect the input terminals of the Model 8420 Digital Multimeter/Counter to the output of the AC voltage standard, as shown in figure 4-5. Adjust the AC voltage standard to an output of 1.0000 volt rms ± 0.02% at a frequency of 100Hz. Adjust R 157 until the display reads 1.0000 ± 2 digits.

4.2.12 Apply an input of 1.000 volt rms ± 0.1% at a frequency of 100KHz. Select a value for C49 to provide a reading of 1.0000 ± 30 digits.

4.2.13 Select the 10 range and apply an input of 10.000 volts rms ± 0.02 % at a frequency of 100 Hz. Adjust R85 until the display reads 10.000 ± 2 digits.

4.2.14 Apply an input of 10.000 volts rms ± 0.1% at a frequency of 100 KHz. Adjust C36 until the display reads 10.000 ± 30 digits.

4.2.15 Select the 100 range and apply an input of 100.00 volts rms ± 0.02% at a frequency of 100 Hz. Adjust R95 until the display reads 100.00 ± 2 digits.

4.2.16 Apply an input of 100.00 volts rms ± 0.1% at a frequency of 100 KHz. Adjust C39 until the display reads 10000 ± 30 digits.

4.2.17 Select the 1000 range and apply an input of 500.0 volts rms ± 0.02% at a frequency of 100Hz. Adjust R106 until the display reads 500.0 ± 2 digits.

4.2.18 Apply an input of 500.0 volts rms ± 0.1% at a frequency of 100 KHz. Adjust C42 until the display reads 500.0 ± 30 digits.

CAUTION

The maximum safe input voltage, on the AC function is 500 volts rms.

4.3 TEST PROCEDURE

The following test porcedure, or any part of it, may be performed as required. This poocedure should only be performed after completing 4.2 CALIBRATION PROCEDURE. This test procedure covers the following specifications for the digital multimeter:

1) Overload indication
2) Input impedance
3) Normal mode rejection
4) Common mode rejection
5) Input sensitivity in frequency mode
6) Resolution
7) Temperature coefficient
8) Line voltage range

NOTE

For all of the following tests the input low lead must be connected to the guard lead at the front panel.

4.3.1 OVERLOAD INDICATION

Select the DC function and the 1 range. Connect the input to a DC voltage source. Adjust the DC voltage source until the

multimeter reads 1.5000. At this reading the overload indicator should illuminate.

4.3.2 INPUT IMPEDANCE

Select the DC function and the 1 range. Connect the input to a DC voltage source. Adjust the DC voltage source until the display reads. 1.0000. Connect a 10KΩ ± 1% resistor in series with the high input lead. The reading should be .9990 ± 1 digit.

4.3.3 NORMAL MODE REJECTION

Select the DC function and the 1 range. Connect the multimeter input to the output of a sine wave generator, as shown in figure 4-6. Adjust the output of the sine wave generator to 0.2 volts peak-to-peak at 60.0 Hz ± .1%. The display should read .0000 ± digit.

4.3.4 COMMON MODE REJECTION

Select the DC function and the 1 range. Short all three input terminals together, connect them to the high output of a sine wave generator. Connect the low output of the sine wave generator to the power line ground, as shown in Figure 4-7. Adjust the output of the sine wave generator to 20 volts peak-to-peak at 60 Hz. The display should read .0000 ± 1 digit.

4.3.5 INPUT SENSITIVITY IN FREQUENCY MODE

Select the KHz function and the 1000 range. Set the front panel sensitivity control fully clockwise. (Early versions of the Model 8420 Digital Multimeter/Counter may not have this control). Apply an input of 1.0000 MHz ± 0.005% with an amplitude of 0.1 volt rms ± 1%. The multimeter should read 1000.0 ± 3 digits. Select the 10000 range. Apply an input of 10.000 MHz ± 0.005% with an amplitude of 0.25 volt rms ± 1%, as shown in Figure 4-4. The display should read 10000. ± 7 digits.

4.3.6 RESOLUTION

Select the DC function and the 1 range. Apply an input of 0.1000 volt DC, as shown in Figure 4-2. Vary the input by precisely 100 microvolts and check that the reading changes 1 digit.

4.3.7 TEMPERATURE COEFFICENT

Select the DC function and the 1 range. Place the unit in an environmental chamber at 25°C and allow a minimum of one hour for the unit to stabilize. Apply both + and - 1.0000 volt DC ± 0.005% and record the readings. Check that the front panel zero control is properly set to read .0000. Raise the temp-

erature in the chamber to +55°C and allow a minimum of one hour for the unit to stablize. Check zero and adjust if necessary. Apply both + and -1.0000 volt DC ± 0.005% and check that the readings previously taken have not changed more than ± 6 digits. The Model 8420 Digital Multimeter/ Counter should be connected as shown in Figure 4-2 for this test.

4.3.8 LINE VOLTAGE RANGE

The following line voltage tests are made around 115 volts AC 60Hz. If the unit is to be used on 230 volts AC or other than 60 Hz, the test should be performed at that voltage or frequency.

Connect the variac to the 115 volt DC 60 Hz line. Connect the wattmeter/voltmeter to the output of the variac and connect the 8420 to the wattmeter/voltmeter output, as shown in Figure 4-8. Apply a full scale 1.0 volt DC input voltage to the Model 8420 Digital Multimeter/Counter. Vary the AC line voltage from 103.5 to 126.5 volts AC an check for a 1 digit or less change in the reading.

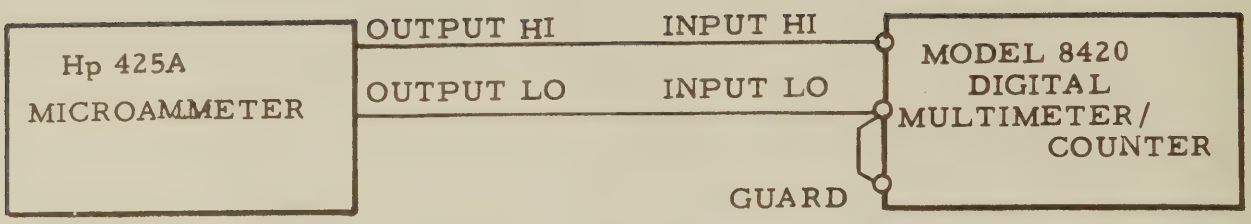


FIGURE 4-1
INPUT CURRENT TEST CIRCUIT

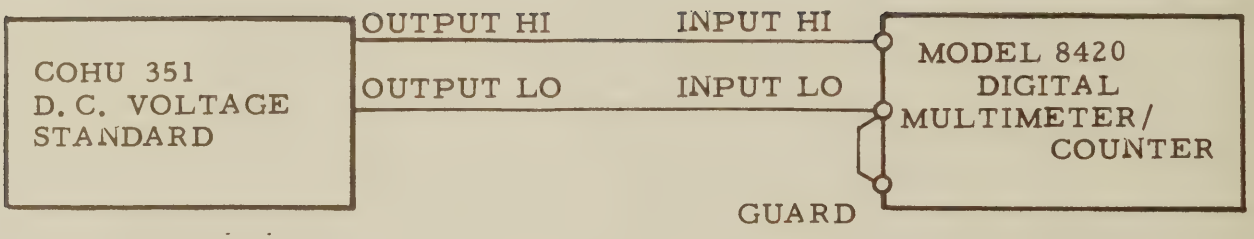


FIGURE 4-2
D. C. VOLTAGE CALIBRATION TEST CIRCUIT

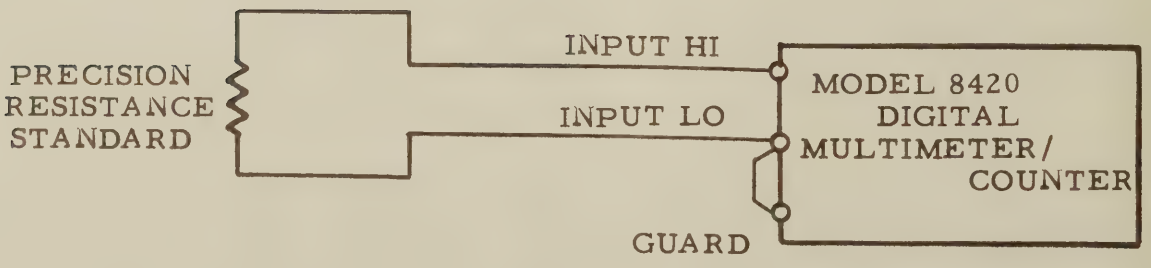


FIGURE 4-3
RESISTANCE CALIBRATION TEST CIRCUIT

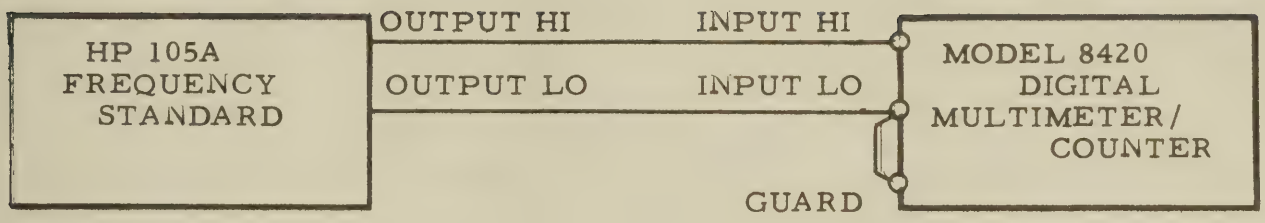


FIGURE 4-4
FREQUENCY CALIBRATION TEST CIRCUIT

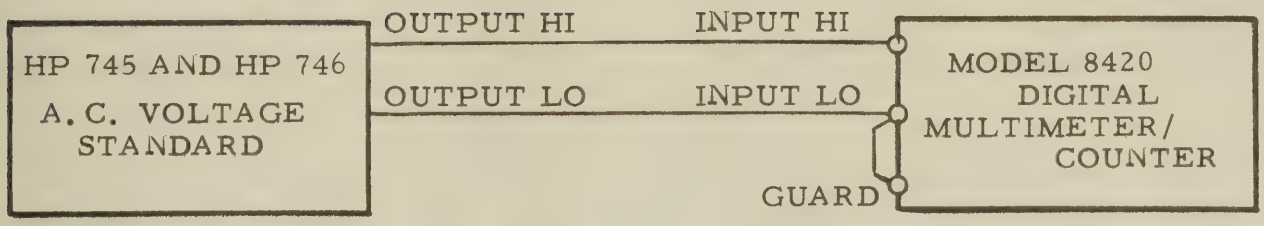


FIGURE 4-5
A.C. VOLTAGE CALIBRATION TEST CIRCUIT

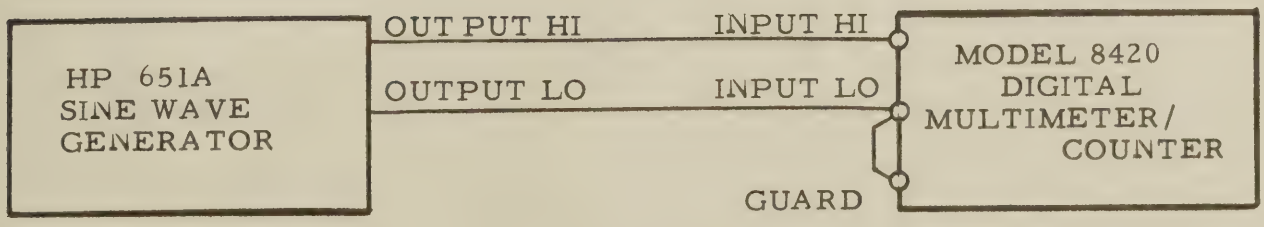


FIGURE 4-6
NORMAL MODE REJECTION TEST CIRCUIT

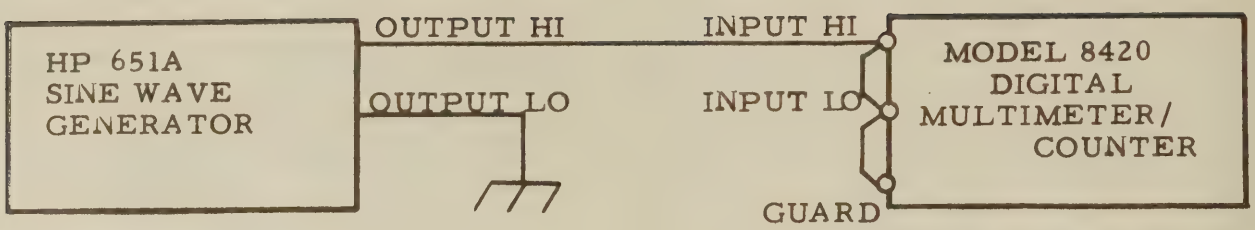


FIGURE 4-7
COMMON MODE REJECTION TEST CIRCUIT

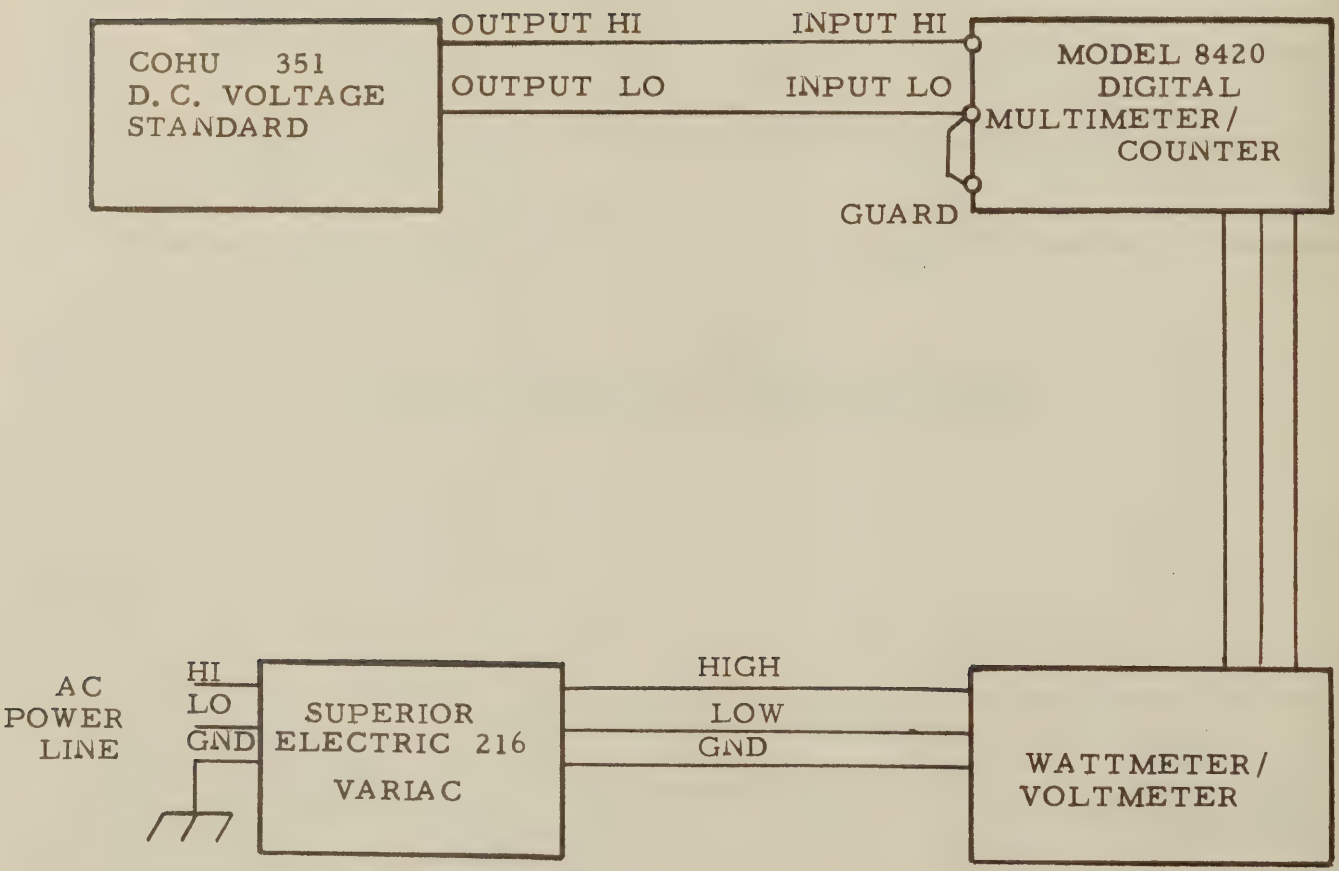


FIGURE 4-8
INPUT POWER AND LINE VOLTAGE VARIATION
TEST CIRCUIT

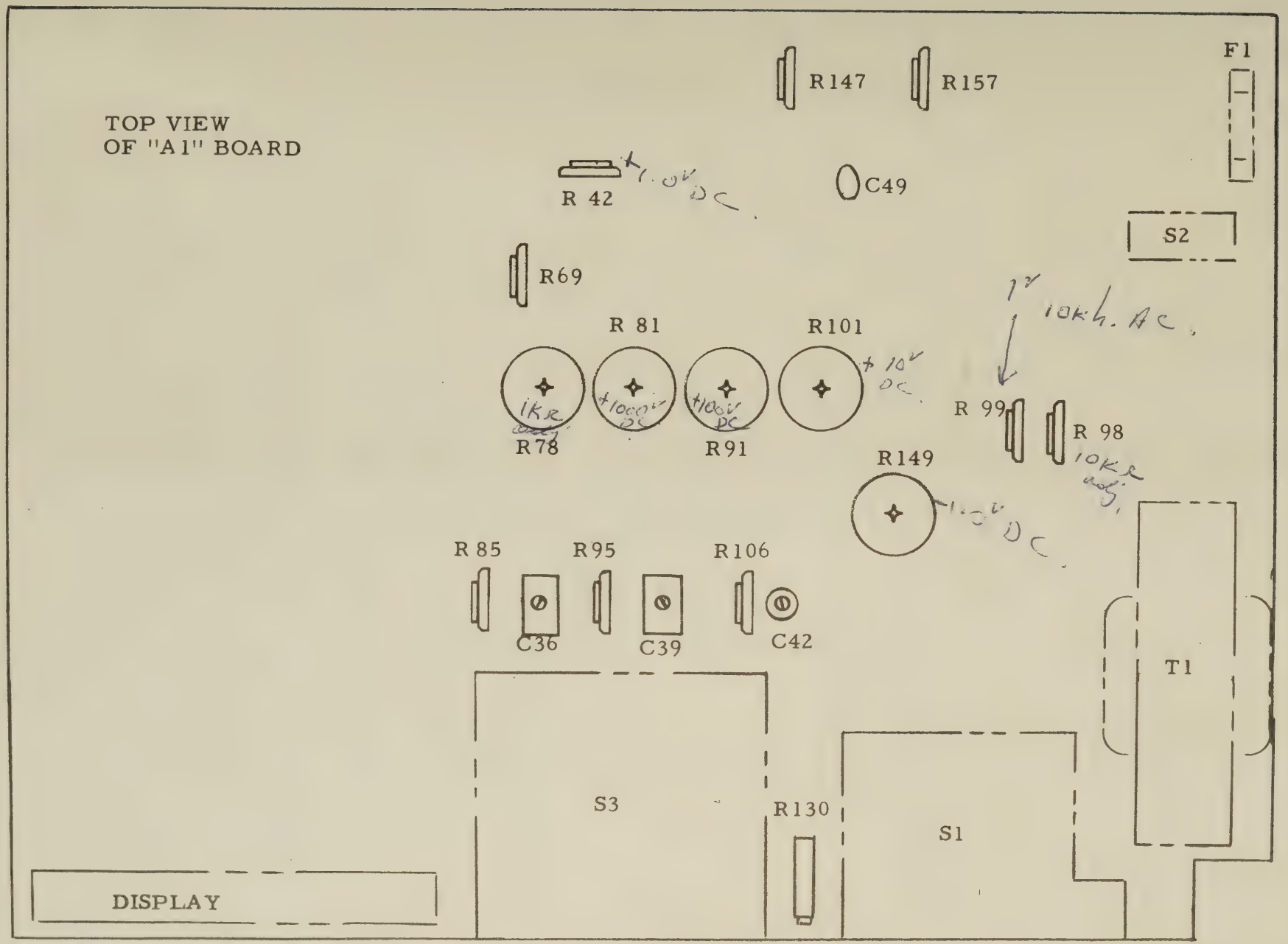


FIGURE 4-9 LOCATION OF ADJUSTMENTS FOR MODEL 8420 DIGITAL MULTIMETER/COUNTER

MAINTENANCE AND TROUBLESHOOTING

5.1 GENERAL MAINTENANCE

The CALICO 8420 Digital Multimeter/Counter is a solid state instrument designed to give years of trouble free service. Since the instrument has no moving parts, maintenance is limited to periodic cleaning in accordance with good commercial shop practices.

5.2 TROUBLESHOOTING

Experience has shown that often the difficulties encountered with equipment are poor input signals or misinterpretation of specifications. Check to be sure that the input is not noisy or erratic, and that characteristics of this instrument as defined in the specifications are fully understood.

Only skilled personnel who have studied the theory of operation section of this manual should attempt to repair the instrument.

WARNING

HIGH VOLTAGE (180 VAC)

This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety percautions. Do not touch electronic circuits when power is applied. Avoid contact with all input and output connections

The following is a guide to localizing the area of the malfunction.

1. Check the +15 volts DC power supply at the emitter of Q2. The +15 volts DC shuld be +15 volts DC ± 10% with less than 10 millivolts of ripple.
2. Check the -15 volts DC power supply at the emitter of Q3. The -15 volts DC should be -15 volts DC +20% -0% with less than 10 millivolts of ripple
3. Check the +5 volts DC power supply at pin 2 of IC19. The +5 volts DC power supply should be between 4.75 and 5.25 volts DC.
4. Check the supply voltage for the display tubes. This supply

should provide 180 volts rms ± 20% at the anode of CR1. The half wave rectified output shouls be at the cathode of CR1.

5. Check that the outputs of the precision reference amplifiers are + and - 6.2 volts DC ± 5%. The +6.2 volts DC output is located at CR11 cathode. The -6.2 volts DC output is located at CR15 anode. The ripple level at these outputs should not exceed 3 millivolts peak-to-peak
6. Check the input amplifier by applying an input of 1 volt DC to the input of the instrument on the 1 volt DC range. The preamplifier output, CR40 cathode, should be 6.2 volts DC ± 5%.
7. Check that the integrator output, which is the junction of R45 and R46, produces a ramping voltage with a slope proportional to the input voltage. Check that the integrator output does not clip on the peak of the triangle.
8. Check that the zero detector output, Q15 collector, changes state as the integrator output passes thru zero.
9. Check that the output of the 1MHz crystal oscillator, IC5 pin 8, is 1 MHz ± 0.05%.

CIRCUIT DIAGRAM

6.1 GENERAL

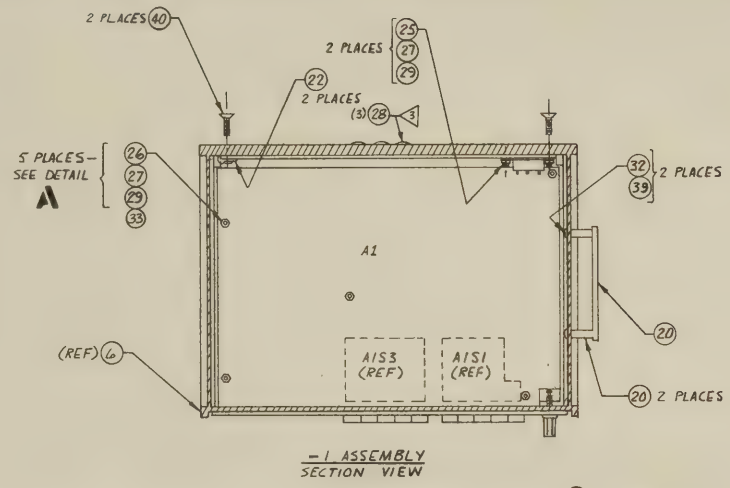
This section contains schematics and mechanical diagrams necessary for operation and maintenance of the 8420 Digital Multimeter/Counter

6.2 REFERENCE DESIGNATIONS

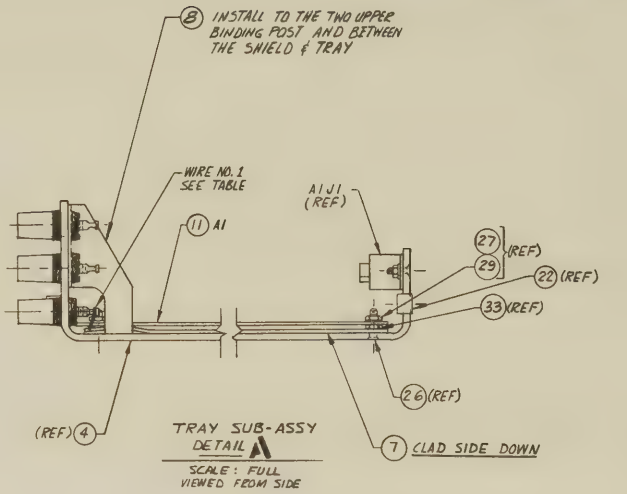
Partial reference designators are shown on schematics and mechanical drawings. Prefix these reference designators with assembly designation for complete reference designation.

ASSEMBLY	COMPONENT	COMPLETE NUMBER
A1	R26	A1R26
A1	IC15	A1IC15
A1	Q4	A1Q4

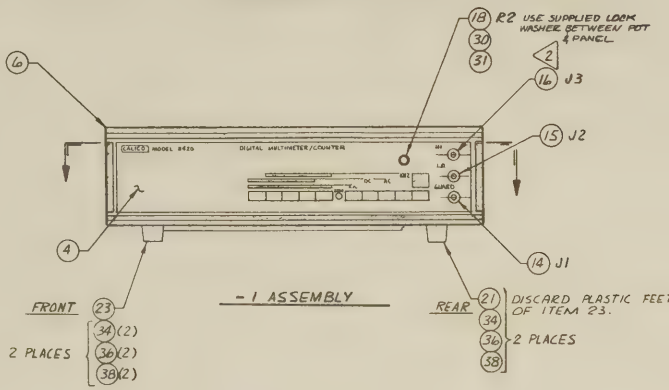
REVISIONS					
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



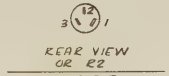
-1 ASSEMBLY
SECTION VIEW



TRAY SUB-ASSY DETAIL A
SCALE: FULL
VIEWED FROM SIDE



-1 ASSEMBLY



REAR VIEW OF R2
NO SCALE

WIRE TABLE

WIRE NO.	FROM	TO	AWG	COLOR	REMARKS
1	SHIELD (ITEM 7)	J1	100Ω RESISTOR		R1 ITEM 17
2	A1-10	J2	20	BLK	EXISTING A1 WIRE
3	A1-9	J3	20	RED	EXISTING A1 WIRE
4	R2-2	A1-7	COAX	RG174/U	SHIELD TIES TO E2-1 AND A1-5
5	R2-3	A1-12	COAX	RG174/U	SHIELD TIES TO R2-1 AND A1-6

ASSEMBLY SEQUENCE (REF)

CASE SUB-ASSY
1. ASSEMBLE ITEM 18 (BAIL) TO ITEM 6 (ENCLOSURE).
2. ASSEMBLE ITEM 5 HANDLE TO ITEM 6 (ENCLOSURE).

TRAY SUB-ASSY (DETAIL "A")
1. TIE "WIRE #1" (RESISTOR) TO ITEM 7 (SHIELD) THRU HOLE.
2. INSTALL ITEM 22 NUT-CLIPS TO ITEM 4 (TRAY)
3. ASSEMBLE ITEM 7 (SHIELD) TO ITEM 4 (TRAY) AS SHOWN IN DETAIL "A" (CLAD SIDE DOWN).
4. ASSEMBLE ITEM 11 (A1) TO TRAY-SHIELD ASSEMBLY.
5. ASSEMBLE ITEMS 14, 15, & 16 (BINDING POSTS) A1J1 & R2 TO ITEM 4 (TRAY).
6. TIE WIRES #2 & #3 TO BINDING POSTS
7. WIRE PER TABLE.

SLIDE TRAY SUB-ASSY INTO CASE SUB-ASSY
ASSEMBLE WITH ITEM 40

3 SPREAD PRONGS ON HOLE PLUGS (ITEM 28) BEFOR INSTALLATION, FOR PROPER FIT.

2. WIRE HOLES IN J1, J2, & J3 TO BE PARALLEL WITH TOP OF UNIT.

1. FOR UNIT SCHEMATIC, SEE DWG E8420-070.

NOTES: (UNLESS OTHERWISE SPECIFIED)

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
	-1	8420-400-1	PARTS LIST	SEE SHEETS 3 & 4				

DIM IN INCHES TOLERANCES: XXX = .010, XX = .03, X = 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES
DWG SIZE: D

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TITLE: UNIT ASSEMBLY, DIGITAL MULTIMETER/COUNTER

CALICO
CALIFORNIA INSTRUMENTS CORP
SAN DIEGO, CALIFORNIA

MODEL 8420
CONTRACT NO.
CODE IDENT 16067

RELEASE		
CHECKER		PURCHASING
DESIGN		PROJ ENGR
DRAFTSMAN	MARTIN M. REED	CHF ENGR

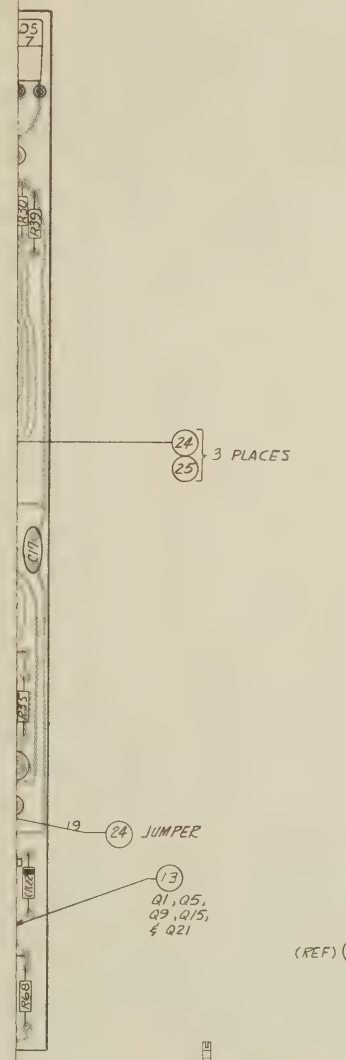
DWG NO. D8420-400 REV D
SCALE: AS NOTED SHEET 2 OF 4

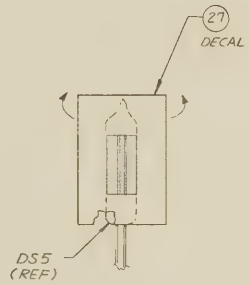
DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

CALICO P-585

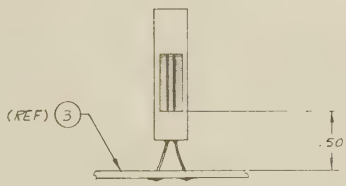
D8420-400 D

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

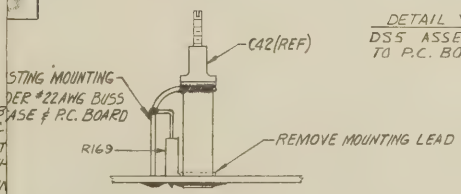




DETAIL "A"
DECAL ASSEMBLY
TO DS5



DETAIL "B"
DS5 ASSEMBLY
TO P.C. BOARD



6 DETAIL "C"
C42 ASSEMBLY TO P.C. BD.

9. MOUNT R78 1/8 OFF P.C.
8. IF DOT EXIST MOUNT WITH
7. PRIOR TO I SWITCH CA
6. C42 & Y1 P.C. BOARD.
5. T1 TRANSFOR POINTS ON POINT ON P.
4. MOUNT PUS WITH LATCHI
3. SOLDER SLI ORIENTED
2. RIVET FUSE ON COMPONE
1. FOR P.C. BOARD

NOTES: (UNLESS OTHERWISE

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
X -1		8420-700-1	PARTS LIST	SEE SHEETS 4 THRU 15				

DIM IN INCHES TOLERANCES XXX ± .010, XX ± .03, X ± .1°
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES
DWG SIZE E
EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

DASH NO	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH
-1	1	8420-400		

TITLE: P.C. BOARD ASSY, DIGITAL MULTIMETER

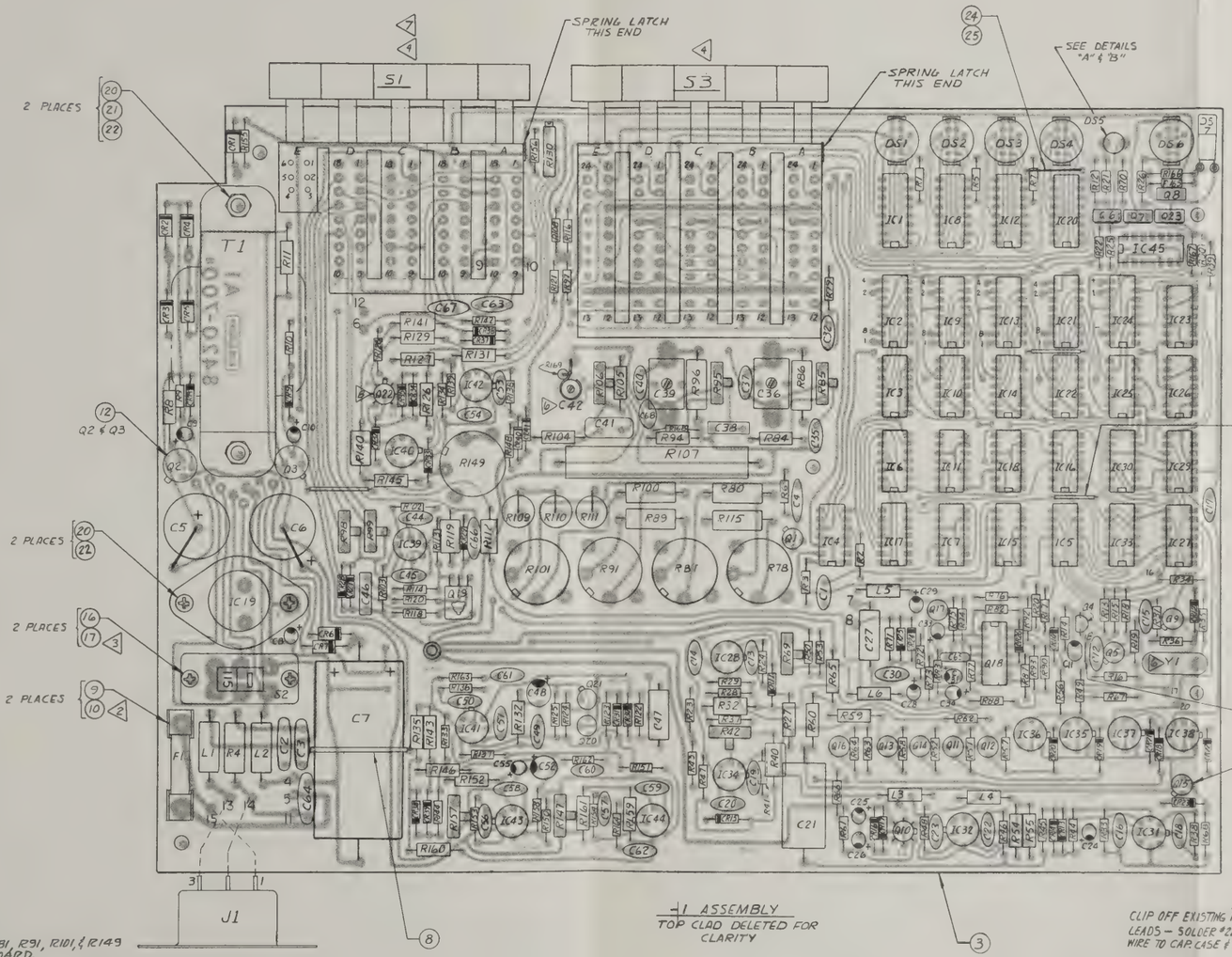
MODEL: 8420
RELEASE: [illegible] 12/17/76
CHECKER: [illegible] PURCHASING
DESIGN: PROJ ENGR
DRFTSMN: W. Hamm 12-3-76 CHF ENGR

CALICO
CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA
CONTRACT NO. CODE IDENT 16067
DWG NO. E8420-700 REV D
SCALE NONE SHEET 2 OF 15

E8420-700 D

A

REVISIONS					
REV	AUTH	DESCRIPTION	ZONE	ECT ON	DATE	APRD



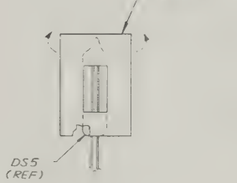
-1 ASSEMBLY
TOP CLAD DELETED FOR CLARITY

REAR VIEW OF J1

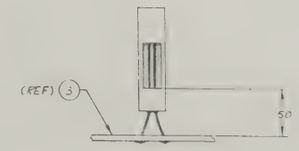
WIRE TABLE					
WIRE NO.	FROM	TO	WIRE TYPE	LENGTH REQD	REMARKS
1 THRU 12	SEE NOTE 5				
13	J1-1	A1-15	#20 AWG-BLK	2.5 INCHES	
14	J1-2	A1-14	#20 AWG-GRN	2.5 INCHES	LACE TOGETHER
15	J1-3	A1-13	#20 AWG-WHT	2.5 INCHES	ON TOP SIDE OF BOARD
16	A1-5 (BLK)	S1-E-5	ITEM 14 - 2-COND SHLD	7.0 INCHES	TIE A1 END SHIELD TO A1-11 SWITCH END SHIELD FLOATS.
17	A1-4 (CLEAR)	S1-E-4			
18					
19	A1-10	—	#20 AWG BLK	6.0 INCHES	LACE TOGETHER
20	A1-9	—	#20 AWG RED	7.0 INCHES	

3. MOUNT R78, R81, R91, R101, & R149 1/8 OFF P.C. BOARD.
4. IF DOT EXISTS ON CASE OF Q22, MOUNT WITH DOT TOWARDS SWITCHES.
4. PRIOR TO INSTALLATION - CUT OFF S1-E LEADS FLUSH WITH SWITCH CASE FAR SIDE ONLY
6. C42 & Y1 CAN NOT EXTEND MORE THAN 1/16 THRU P.C. BOARD. SEE DETAIL 'C' FOR C42 INSTALLATION.
5. T1 TRANSFORMER WIRES TIE TO CORRESPONDING COLOR CODED POINTS ON P.C. BOARD. (i.e. T1-YEL WIRE TIES TO "YEL" TIE POINT ON P.C. BOARD, ETC.)
4. MOUNT PUSHBUTTON SWITCHES S1 & S3 .062 OFF BOARD, WITH LATCHING SPRINGS LOCATED AS SHOWN.
3. SOLDER SLIDE SWITCH TO BOARD WITH "115" ORIENTED AS SHOWN.
2. RIVET FUSE CLIPS TO BOARD WITH RIVET HEAD ON COMPONENT SIDE OF BOARD.
1. FOR P.C. BOARD SCHEMATIC DIAGRAM, SEE DWG NO. E8420-070.

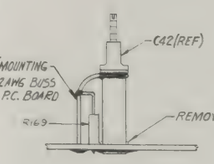
NOTES: (UNLESS OTHERWISE SPECIFIED)



DETAIL "A"
DECAL ASSEMBLY TO DS5



DETAIL "B"
DSS ASSEMBLY TO P.C. BOARD

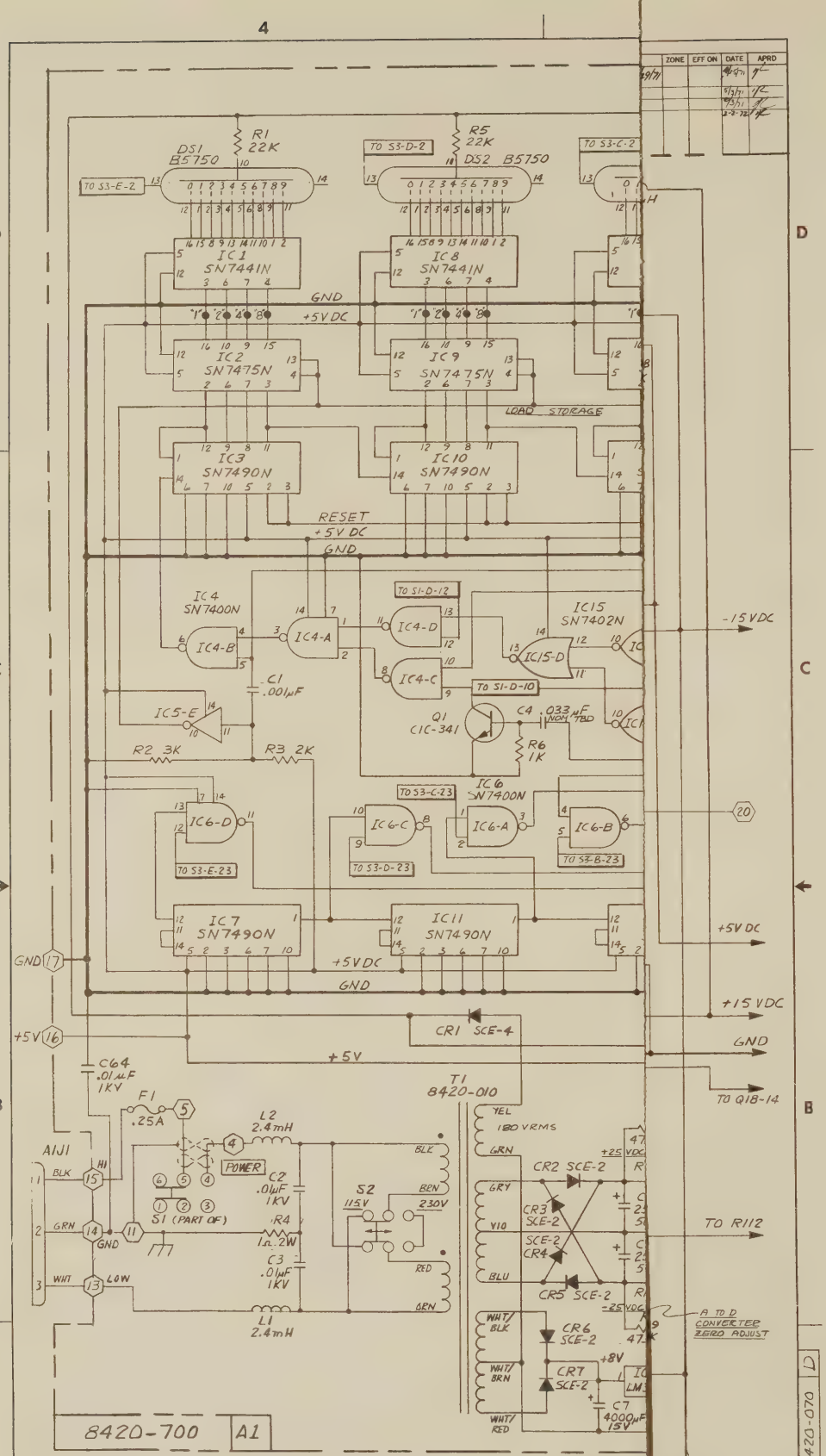


DETAIL "C"
C42 ASSEMBLY TO P.C. BD.

ITEM NO	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES	ZONE
REQD PER ASSY	8420-700-1	PARTS LIST	SEE SHEETS 4 THRU 15				

DIM IN INCHES TOLERANCES .XX ± .03 .XXX ± .010 ANGLES ± 1°
BREAK ALL SHARP CORNERS & EDGES MACHINE SURFACES
DWG SIZE: E
TITLE: P.C. BOARD ASSY, DIGITAL MULTIMETER
CALICO — CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA
MODEL: 8420
CONTRACT NO
CODE IDENT: 16067
RELEASED
CHECKED
DESIGN
DRAFTSMAN
PROJ ENGR
PURCHASING
CHF ENGR
DWG NO: E 8420-700
REV: D
SCALE: NONE
SHEET 2 OF 15
DASH NO | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH: 8420-400

E8420-700 D



7. '1' '2' ETC. INDICATES BCD OUTPUT OPTION
6. (X) INDICATES NUMBERED WIRE TIE POINT ON P.C. BOARD.
5. SWITCH TERMINAL IDENTIFICATION IS FOR REFERENCE ONLY.
4. [ ] INDICATES FRONT PANEL CONTROLS.
3. CAPACITANCE IN MICROFARADS; VOLTAGE RATING 100VDC.
2. RESISTORS ARE 1/4 W, 5%. VALUE IN OHMS.
1. DIODES ARE IN914.

NOTES: (UNLESS OTHERWISE SPECIFIED)

OPTIONAL IN914 D... VOLTAGE OF NOT ... AT EMITTER OF

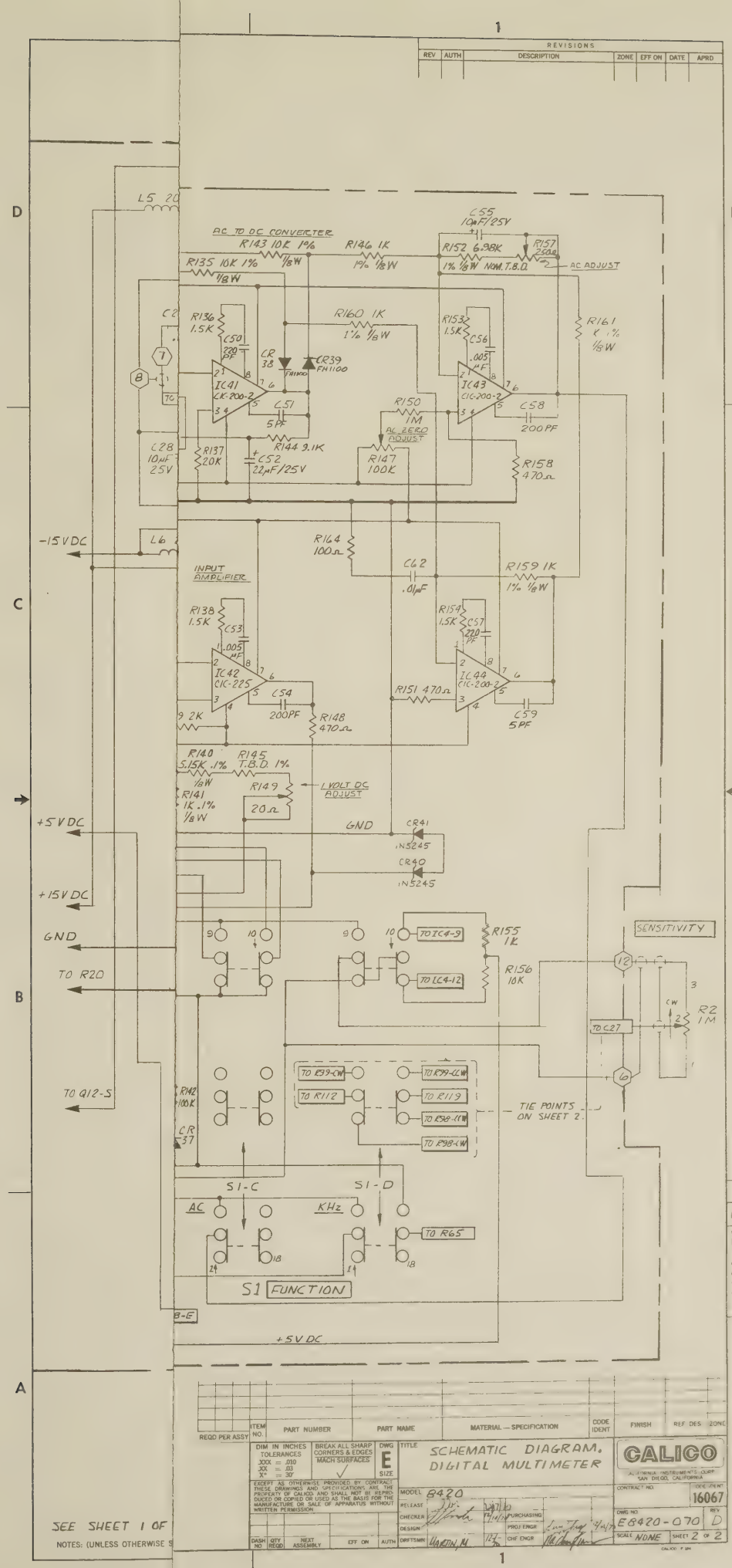
ZONE	EFF ON	DATE	APRD
		4/5/71	
		5/5/71	
		7/5/71	
		2-2-72	

CALICO
CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

CONTRACT NO.	CODE IDENT
	16067

DWG NO. E8420-070 REV D
SCALE NONE SHEET 1 OF 2
CALICO F-104

E8420-070 D


REVISIONS
REV | AUTH | DESCRIPTION | ZONE | EFF ON | DATE | APRD
AC TO DC CONVERTER
R143 10K 1%
R146 1K
R135 10K 1%
1/8W
1% 1/8W
R152 6.98K
1% 1/8W NOM. T.B.O.
R157 250Ω
AC ADJUST
C55 10μF/25V
R136 1.5K
C50 220 PF
CR 38
CR39 FH1100
R160 1K
1% 1/8W
R153 1.5K
C56 .005 μF
R161 K 1% 1/8W
IC41 CLK-200-2
C51 5PF
R150 1M
AC ZERO ADJUST
IC43 CIC-200-2
C58 200PF
R144 9.1K
C28 10μF 25V
R137 20K
C52 22μF/25V
R147 100K
R158 470Ω
-15VDC
L6
R164 100Ω
C62 .01μF
R159 1K
1% 1/8W
INPUT AMPLIFIER
R138 1.5K
C53 .005 μF
R154 1.5K
C57 220 PF
IC42 CIC-225
C54 200PF
IC44 CIC-200-2
R151 470Ω
C59 5PF
R148 470Ω
R140 5.15K .1% 1/8W
R145 T.B.O. 1%
R141 1K .1% 1/8W
R149 20Ω
LVOLT DC ADJUST
+5VDC
GND
CR41 IN5245
CR40 IN5245
+15VDC
GND
TO R20
TO IC4-9
TO IC4-12
R155 1K
R156 10K
SENSITIVITY
TO C27
R2 1M
CW
TO Q12-S
R142 100K
CR 37
TO R39-CW
TO R112
TO R39-CCW
TO R113
TO R38-CCW
TO R38-CW
TIE POINTS ON SHEET 2.
S1-C
S1-D
AC
KHz
TO R65
S1 FUNCTION
+5V DC
SEE SHEET 1 OF
NOTES: (UNLESS OTHERWISE S
ITEM NO. | PART NUMBER | PART NAME | MATERIAL — SPECIFICATION | CODE IDENT | FINISH | REF DES | ZONE
REQD PER ASSY
DIM IN INCHES TOLERANCES XXX = .010 XX = .03 X° = 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES
DWG SIZE E
TITLE SCHEMATIC DIAGRAM. DIGITAL MULTIMETER
CALICO
CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA
EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO, AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.
MODEL 8420
RELEASE
CHECKER
DESIGN
DRAFTSMAN HARTON, M
PURCHASING
PROJ ENGR
CHF ENGR
CONTRACT NO.
CODE IDENT 16067
DWG NO E8420-070
REV D
SCALE NONE
SHEET 2 OF 2
DASH NO | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH
E8420-070 D

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APPD
A	E.O.	INCORP. E.O. 433 W/ [illegible] 454			4/4/ [illegible]	
B	E.O.	INC E.O. #37			[illegible]	
C	E.O.	INC E.O. 435, [illegible]			[illegible]	
D	E.O.	INC E.O. 454 & 466			[illegible]	

8420-700 A1

7. '1' '2' ETC. INDICATES BCD OUTPUT OPTION
6. (X) INDICATES NUMBERED WIRE TIE POINT ON P.C. BOARD.
5. SWITCH TERMINAL IDENTIFICATION IS FOR REFERENCE ONLY.
4. [ ] INDICATES FRONT PANEL CONTROLS.
3. CAPACITANCE IN MICROFARADS; VOLTAGE RATING 100VDC.
2. RESISTORS ARE 1/4W, 5%. VALUE IN OHMS.
1. DIODES ARE IN914.

NOTES: (UNLESS OTHERWISE SPECIFIED)

▷ OPTIONAL IN914 DIODE TO PROVIDE A VOLTAGE OF NOT LESS THAN 15.00V AT EMITTER OF Q3.

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	IDENT	FINISH	REF DES	ZONE
REQD PER ASSY							

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'

BREAK ALL SHARP CORNERS & EDGES 1/64 INCH MAX

DWG SIZE E

TITLE SCHEMATIC DIAGRAM, DIGITAL MULTIMETER

CALICO — CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

MODEL 8420 | CONTRACT NO. | CODE IDENT 16067

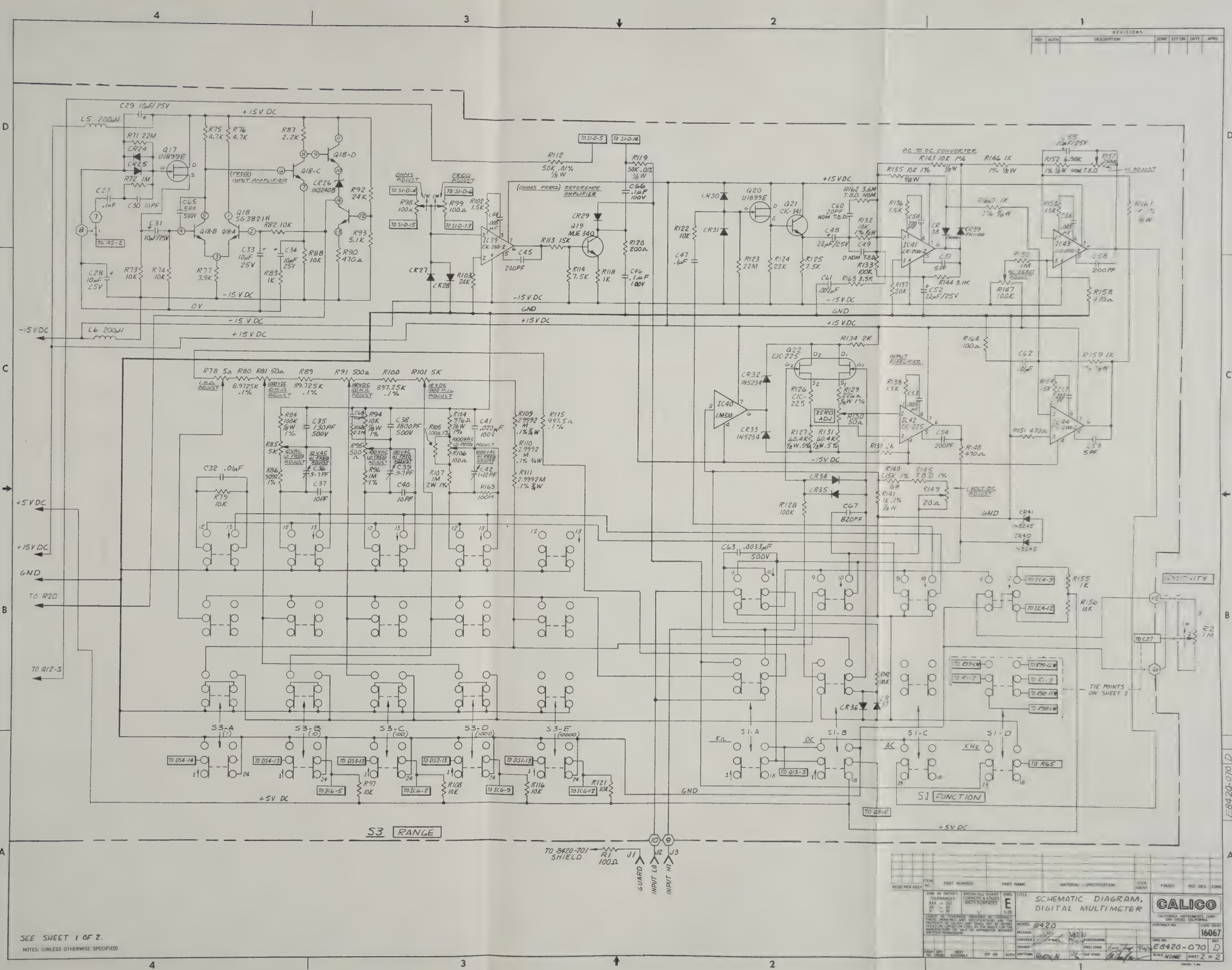
RELEASE | CHECKED | DESIGN | DRFTSMN | PROJ ENGR | CHF ENGR | PURCHASING

DWG NO. E8420-070 | REV D

DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

SCALE NONE | SHEET 1 OF 2

E8420-070 D


REVISIONS
REV | AUTH | DESCRIPTION | ZONE | EFF ON | DATE | APPD
C29 10μF/25V
+15V DC
L5 200μH
R71 22M
CR24
CR25
Q17 U1899E
R72 1M
C27 .1μF
C30 10PF
C65 5PF 500V
C31 10μF/25V
TO A2-2
C28 10μF 25V
R73 10K
R74 10K
R75 4.7K
R76 4.7K
R87 2.2K
Q18-D
Q18-C
CR26 INS2405
R92 24K
R93 5.1K
R90 470Ω
Q18 SG3821N
Q18-B
Q18-A
R82 10K
C33 10μF 25V
C34 10μF 25V
R88 10K
R83 1K
R77 3.9K
-15V DC
0V
(FREQ) INPUT AMPLIFIER
L6 200μH
TO S1-D-5
TO S1-D-14
R112 50K .01% 1/8W
R119 50K .01% 1/8W
OHMS ADJUST
FREQ ADJUST
TO S1-D-4
TO S1-D-6
TO S1-D-15
TO S1-D-13
R98 100Ω
R99 100Ω
R102 1.5K
.1μF .005 MF
IC39 CLK-200-2
(OHMS FREQ) REFERENCE AMPLIFIER
CR29
Q19 MJE 340
R113 15K
C45 200PF
C46 .1μF 100V
C66 .1μF 100V
R120 200Ω
R114 7.5K
R118 1K
CR27
CR28
R103 24K
GND
+15V DC
-15V DC
AC TO DC CONVERTER
R143 10K 1%
R146 1K
R135 10K 1% 1/8W
R157 500Ω
R152 6.98K 1% 1/8W NOM T.B.D.
AC ADJUST
C55 10μF/25V
CR30
CR31
Q20 U1899E
Q21 CIC-341
R122 10K
C47 .1μF
R123 22M
R124 22K
R125 7.5K
R162 3.6M T.B.D. NOM
C60 20PF NOM T.B.D.
C48 22μF/25V
R32 10K 1% 1/8W
C49 0 NOM T.B.D.
R133 100K
R163 3.9K
C61 .002μF
R134 1.5K
C50 220 PF
IC41 CLK-200-2
CR38 FAIRCHILD
CR39 FN1100
C51 5PF
R137 20K
C52 22μF/25V
R144 9.1K
R160 1K
R147 100K
2.50 1M AC ZERO ADJUST
R153 15K
C56 .005
IC43 CLK-200-2
C58 200PF
R161 1K 1% 1/8W
R158 470Ω
R134 2K
Q22 CIC 225
CR32 IN5234
IC40 LM310
CR33 IN5234
R126 CIC-225
R129 22Ω 1/8W 1%
ZERO ADJ
R130 50Ω
R127 60.4K 1/8W 5%
R131 60.4K 1/8W 5%
R139 2K
INPUT FIABILITY
R138 1.5K
C53 .005
IC42 CIC-225
C54 200PF
R148 470Ω
R164 100Ω
C62 .01μF
R159 1K
R154 1.5K
C57 5PF
IC44 CIC-200-2
R151 473Ω
C59 5PF
-15V DC
R140 5.15K 1% 1/8W
C185 T.B.D. 1%
R149 20Ω
1 VOLT DC ADJUST
R141 1K .1% 1/8W
C67 820PF
R128 100K
CR34
CR35
CR41 IN5245
CR40 IN5245
GND
R78 5Ω
R80 8.9725K .1%
R81 50Ω
R89 89.725K .1%
R91 500Ω
R100 897.25K .1%
R101 5K
1000 VDC 10K Ω ADJUST
100 VDC 100K Ω ADJUST
10 VDC 1000 Ω ADJUST
LINEAR ADJUST
R84 100K 1/8W 1%
C35 130PF 500V
R85 5K
10 VAC LO FREQ ADJUST
10 VAC HI FREQ ADJUST
R86 909K 1%
C36 3-7PF
C37 10PF
C32 .01μF
R79 10K
C68 Trimpot
R94 10K 1/8W 1%
R95 9.27K
C38 1800PF 500V
R96 1M 1%
C39 3-7PF
C40 10PF
100 VAC LO FREQ ADJUST
100 VAC HI FREQ ADJUST
R105 100Ω 1%
1000 VAC LO FREQ ADJUST
R106 100Ω
R107 1M 2W 1%
R104 976Ω 1/8W 1%
C41 .020μF 100V
C42 1-12PF
R163 100Ω
R109 2.9992 M .1% 3/4W
R110 2.9992 M .1% 3/4W
R111 2.9992M .1% 3/4W
R115 997.5Ω .1%
R97 10K
R108 10K
R116 10K
R121 10K
TO IC4-5
TO IC4-2
TO IC4-9
TO IC4-12
R155 1K
R156 10K
SENSITIVITY
R2 1M
TO C87
TO DS4-16
TO DS4-13
TO DS3-13
TO DS2-13
TO DS1-13
TO IC4-6
TO IC4-3
TO IC4-11
TO IC4-8
S3-A (1)
S3-B (10)
S3-C (100)
S3-D (1000)
S3-E (10000)
S3 RANGE
+5V DC
GND
TO R20
TO Q12-S
TO 8420-701 SHIELD
R1 100Ω
J1 GUARD
J2 INPUT LO
J3 INPUT HI
CR36
CR37
R142 10K
TO S1-B
TO S1-C
TO S1-D
TO R65
TO Q13-S
TO Q8-E
S1-A
S1-B
S1-C
S1-D
Ω
DC
AC
KHz
S1 FUNCTION
TIE POINTS ON SHEET 2
C63 .0033μF 500V
SEE SHEET 1 OF 2.
NOTES: (UNLESS OTHERWISE SPECIFIED)
ITEM NO | PART NUMBER | PART NAME | MATERIAL — SPECIFICATION | CODE IDENT | FINISH | REF DES | ZONE
REQD PER ASSY
DIM IN INCHES TOLERANCES XXX = .000 XX = .02 X = .10
BREAK ALL SHARP CORNERS & EDGES MACHINE SURFACES
SIZE E
TITLE SCHEMATIC DIAGRAM, DIGITAL MULTIMETER
CALICO
CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA
MODEL 8420
CONTRACT NO. 16067
DRAWN
CHECKED
DESIGN
RELEASE
PROJ ENGR
D/F ENGR
DWG NO. E8420-070
REV D
SCALE NONE
SHEET 2 OF 2
E8420-070 D

7.1 GENERAL

This section contains ordering information and complete list of replaceable parts. Parts are listed by major assembly in alpha-numerical order of their reference disignators. Description, manufactures' part number, manufactures' code ident number (see Appendix A for list of manufacturers), and CALICO's stock number are indicated.

7.2 ORDERING INFORMATION

In order to provid our customers with prompt service on replacement parts, please provide the following information, when applicable, for each part ordered:

a) Model number and serial number of the instrument,

b) CALICO part number of the sub-assembly where component is located,

c) Component reference disignator,

d) Component description,

e) Component manufacturer's number and code ident,

f) CALICO stock number.

All replacement parts orders should be placed with CALIFORNIA INSTRUMENTS COMPANY, a division of Aiken Industries, San Diego, California, 92111.

CALICO | CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | **PARTS LIST**

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	8420-400-1	MULTIMETER ASSY	16067		1
					2
					3
	D8420-200-1	TRAY, FRONT PANEL	16067	2-10350	4
					5
	D8420-207-1	ENCLOSURE ASSY	16067	1-10263	6
	C8420-701-7	SHIELD	16067	1-60127	7
	C8420-209-7	BRACKET	16067	1-10270	8
					9
					10
A1	E8420-700-1	P.C. BOARD ASSY	16067		11
					12
					13
J1	1517-BLK	BINDING POST, BLACK	83330	2-50147	14
J2	1517-WHT	BINDING POST, WHITE	83330	2-50148	15
J3	1517-RED	BINDING POST, RED	83330	2-50149	16
R1	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	17
R2	B8420-013-1	POTENTIOMETER 1MΩ	16067	5-70169	18
	327	SHORTING STRAP	83330	2-50159	19
	13754-A-1032-1B	HANDLE	06540	2-10356	20
	2091	RUBBER FOOT	08065	2-10146	21
	A4972-4A-82	NUT-CLIP, FLOATING	22599	2-10353	22
	10" BAIL SET	BAIL	21604	2-10351	23
	17258	POWER CORD	70903	2-41094	24
	4-40 UNCx 5/16 Lg.	SCREW, FLAT HD. 100°			25
	4-40 UNCx 7/16 Lg.	SCREW, FLAT HD. 100°			26
	4-40 UNCx3/16Hex	MACHINE NUT			27
	653	HOLE PLUG	83330		28
	#4	LOCKWASHER, INT STAR			29
	020-122	KNOB	0000K	2-10386	30
	040-102	KNOB CAP	0000K	2-10387	31
	10-32 UNC x 3/8 Lg	SCREW, PAN HD.			32
	N4-40-X	NUT NYLON	95987	2-10136	33
	6-32 UNC x 5/8 Lg	SCREW, PAN HD.			34
					35
	6-32 UNC x 1/4 Hex	MACHINE NUT			36

MODEL	8420	CALICO P/N	8420-400	D	ASSY R.D.
TITLE	DIGITAL MULTIMETER/COUNTER ASSEMBLY	SHT 3	OF 4		

CALICO | CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | **PARTS LIST**

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
					37
	#6	LOCKWASHER, INT STAR			38
	#10	LOCKWASHER, INT STAR			39
	8-32 UNC x 7/8Lg	SCREW, FLAT HD, 100°			40

MODEL	8420	CALICO P/N	8420-400	ASSY R.D.
TITLE	DIGITAL MULTIMETER/COUNTER ASSEMBLY	SHT 4	OF 4	

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REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1	8420-700-1	P.C. BOARD ASSY	16067		1
					2
	8420-700-7	P.C. BOARD	16067	1-60126	3
	1530B-1/4	STANDOFF	88245	2-10303	4
SEE	9536B-A-0440	STANDOFF	06540	2-10349	5
SHEET 3	1299B-1	TERMINAL	88245	2-50146	6
	2010B-1	TERMINAL	88245	2-50076	7
	2829-115-3	MOUSETAIL	98159	2-10151	8
	121002	FUSEHOLDER	75915	2-40262	9
	1236	RIVET	73734	2-10166	10
					11
	RCT05075-7A	TRANSIPAD, TO-5	19080	2-40296	12
	RCT018110-1A	TRANSIPAD, TO-18	19080	2-40297	13
	8762	WIRE, SHIELDED, 2-COND	70903		14
					15
	4-40 UNC x 1/4 LG.	SCREW, PAN HEAD			16
	#4	LOCKWASHER, INT STAR			17
					18
					19
	6-32 UNC x 5/16 LG	SCREW, PAN HEAD			20
	6-32 UNC	HEX MACHINE NUT			21
	#6	LOCKWASHER, INT STAR			22
					23
	#24 AWG	BUSS WIRE			24
	#24 AWG	TEFLON SLEEVING			25
	RG 174/U	CABLE, COAX	81349		26
	8420-100	DECAL, NEON	16067	2-10355	27
A1C1	5HK-D10	CAPACITOR .001μf/1KV	56289	6-10062	28
A1C2	5HK-S10	CAPACITOR .01μf/1KV	56289	6-10768	29
A1C3	5HK-S10	CAPACITOR .01μf/1KV	56289	6-10768	30
A1C4	225P33391	CAPACITOR .033μf/100V	56289	6-10732	31
A1C5	39D257G050HE4	CAPACITOR 250μf/50V	56289	6-10495	32
A1C6	39D257G050HE4	CAPACITOR 250μf/50V	56289	6-10495	33
A1C7	39D408G015JL4	CAPACITOR 4000μf/15V	56289	6-10631	34
A1C8	T360B106M025AS	CAPACITOR 10μf/25V	05397	6-10738	35
A1C9	T360B106M025AS	CAPACITOR 10μf/25V	05397	6-10738	36

MODEL	8420	CALICO P/N	8420-700	D	ASSY R.D.
TITLE	P.C. BOARD ASSY, DIGITAL MULTIMETER	SHT 4	OF 15		A1

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PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1C10	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	37
A1C11	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	38
A1C12	5HK-D10	CAPACITOR .001µf/1KV	56289	6-10062	39
A1C13	TG-D50	CAPACITOR .005µf/100V	56289	6-10770	40
A1C14	CM05FD201J03	CAPACITOR 200pf/500V	81349	6-10282	41
A1C15	CM05CD050D03	CAPACITOR 5pf/500V	81349	6-10483	42
A1C16	CM05E200J03	CAPACITOR 20pf/500V	81349	6-10008	43
A1C17	CM05FD101J03	CAPACITOR 100pf/500V	81349	6-10027	44
A1C18	DM-15-501J	CAPACITOR 500pf/500V	72136	6-10649	45
A1C19	TG-D50	CAPACITOR .005µf/100V	56289	6-10770	46
A1C20	CM05FD201J03	CAPACITOR 200pf/500V	81349	6-10282	47
A1C21	PA2A224	CAPACITOR .22µf/50V	27556	6-10772	48
A1C22	CM05FD201J03	CAPACITOR 200pf/500V	81349	6-10282	49
A1C23	TG-D50	CAPACITOR .005µf/100V	56289	6-10770	50
A1C24	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	51
A1C25	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	52
A1C26	T360B476M006AS	CAPACITOR 47µf/6V	05397	6-10775	53
A1C27	225P10491	CAPACITOR .1µf/100V	56289	6-10720	54
A1C28	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	55
A1C29	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	56
A1C30	CM05CD100J03	CAPACITOR 10pf/500V	81349	6-10004	57
A1C31	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	58
A1C32	TG-S10	CAPACITOR .01µf/100V	56289	6-10759	59
A1C33	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	60
A1C34	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	61
A1C35	CM05FD131J03	CAPACITOR 130pf/500V	81349	6-10278	62
A1C36	400	CAPACITOR, Variable .9-7pf	72136	6-10762	63
A1C37	CM05CD100J03	CAPACITOR 10pf/500V	81349	6-10004	64
A1C38	CM06F182J03	CAPACITOR 1800pf/500V	81349	6-10054	65
A1C39	400	CAPACITOR, Variable .9-7pf	72136	6-10762	66
A1C40	CM05CD100J03	CAPACITOR 10pf/500V	81349	6-10004	67
A1C41	1DP-1-203	CAPACITOR .02µf/100V	72136	6-10100	68
A1C42	VC58G	CAPACITOR, Variable 1-12pf	73899	6-10458	69
A1C43	NOT USED				70
A1C44	TG-D50	CAPACITOR .005µf/100V	56289	6-10770	71
A1C45	CM05FD201J03	CAPACITOR 200pf/500V	81349	6-10282	72

MODEL	CALICO P/N	ASSY R.D.
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TITLE	SHT 5 OF 15	A1
P.C. BOARD ASSY, DIGITAL MULTIMETER		

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PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1C46	TG-P10	CAPACITOR .1pf/100V	56289	6-10127	73
A1C47	225P10491	CAPACITOR .1µf/100V	56289	6-10720	74
A1C48	T360C226M025AS	CAPACITOR 22µf/25V	05397	6-10746	75
A1C49	CM05	CAPACITOR T.B.D.			76
A1C50	CM05FD221J03	CAPACITOR 220pf/500V	81349	6-10036	77
A1C51	CM05CD050D03	CAPACITOR 5pf/500V	81349	6-10483	78
A1C52	T360C226M025AS	CAPACITOR 22µf/25V	05397	6-10746	79
A1C53	TG-D50	CAPACITOR .005µf/100V	56289	6-10770	80
A1C54	CM05FD201J03	CAPACITOR 200pf/500V	81349	6-10282	81
A1C55	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	82
A1C56	TG-D50	CAPACITOR .005µf/100V	56289	6-10770	83
A1C57	CM05FD221J03	CAPACITOR 220pf/500V	81349	6-10036	84
A1C58	CM05FD201J03	CAPACITOR 200pf/500V	81349	6-10282	85
A1C59	CM05CD050D03	CAPACITOR 5pf/500V	81349	6-10483	86
A1C60	CM05ED200J03	CAPACITOR 20pf/500V	81349	6-10008	87
A1C61	5GA-D20	CAPACITOR .002µf/1KV	56289	6-10055	88
A1C62	TG-S10	CAPACITOR .01µf/100V	56289	6-10759	89
A1C63	CM06FD332J03	CAPACITOR .0033µf/500V	81349	6-10779	90
A1C64	5HK-S10	CAPACITOR .01µf/1KV	56289	6-10768	91
A1C65	CM05C050D03	CAPACITOR 5pf/500V	81349	6-10483	92
A1C66	TG-P10	CAPACITOR .1µf/100V	56289	6-10127	93
A1C67	CM05F821J03	CAPACITOR 820pf/500V	81349	6-10050	94
A1C68	CM05C100J03	CAPACITOR 10pf	81349	6-10004	95
					96
					97
					98
A1CR1	SCE-4	DIODE	14099	3-10084	99
A1CR2	THRU A1CR7:				100
	SCE-2	DIODE	14099	3-10079	101
A1CR8	IN5246	DIODE, ZENER	04713	3-10068	102
A1CR9	IN5246B	DIODE, ZENER	04713	3-10173	103
A1CR10	IN914	DIODE	15818	3-10118	104
A1CR11	C1C 705	DIODE, ZENER	16067	3-10197	105
A1CR12	IN914	DIODE	15818	3-10118	106
A1CR13	IN914	DIODE	15818	3-10118	107
A1CR14	IN914	DIODE	15818	3-10118	108

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TITLE	P.C. BOARD ASSY, DIGITAL MULTIMETER	SHT 6 OF 15	A1

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REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1CR15	IN914	DIODE	15818	3-10118	109
A1CR16	IN914	DIODE	15818	3-10118	110
A1CR17	IN914	DIODE	15818	3-10118	111
A1CR18	IN914	DIODE	15818	3-10118	112
A1CR19	IN914	DIODE	15818	3-10118	113
A1CR20	IN914	DIODE	15818	3-10118	114
A1CR21	IN914	DIODE	15818	3-10118	115
A1CR22	IN914	DIODE	15818	3-10118	116
A1CR23	IN914	DIODE	15818	3-10118	117
A1CR24	IN914	DIODE	15818	3-10118	118
A1CR25	IN914	DIODE	15818	3-10118	119
A1CR26	IN5240 B	DIODE, ZENER	04713	3-10169	120
A1CR27	IN914	DIODE	15818	3-10118	121
A1CR28	IN914	DIODE	15818	3-10118	122
A1CR29	IN914	DIODE	15818	3-10118	123
A1CR30	IN914	DIODE	15818	3-10118	124
A1CR31	IN914	DIODE	15818	3-10118	125
A1CR32	IN5234	DIODE, ZENER	04713	3-10204	126
A1CR33	IN5234	DIODE, ZENER	04713	3-10204	127
A1CR34	IN914	DIODE	15818	3-10118	128
A1CR35	IN914	DIODE	15818	3-10118	129
A1CR36	IN914	DIODE	15818	3-10118	130
A1CR37	IN914	DIODE	15818	3-10118	131
A1CR38	FH1100	DIODE	02335	3-10212	132
A1CR39	FH1100	DIODE	02335	3-10212	133
A1CR40	IN5245	DIODE, ZENER	04713	3-10067	134
A1CR41	IN5245	DIODE, ZENER	04713	3-10067	135
					136
					137
					138
					139
A1DS1	B5750	DISPLAY TUBE	83594	2-30031	140
A1DS2	B5750	DISPLAY TUBE	83594	2-30031	141
A1DS3	B5750	DISPLAY TUBE	83594	2-30031	142
A1DS4	B5750	DISPLAY TUBE	83594	2-30031	143
A1DS5	A-261	DISPLAY TUBE, NEON	74276	2-41081	144

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P. C. BOARD ASSY, DIGITAL MULTIMETER		

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PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1DS6	B5856	DISPLAY TUBE, POL	83594	2-30036	145
A1DS7	99-33081-6P46-020	INDICATOR LAMP	87034	2-50160	146
					147
					148
					149
A1F1	313.250	FUSE, .25A, SLO-BLO	75915	2-40258	150
230 Only	MDL-1/8A	FUSE 1/8A SLO-BLO	71400	2-70024	151
					152
					153
					154
A1IC1	SN7441N	INTEGRATED CIRCUIT	27014	3-60003	155
A1IC2	SN7475N	INTEGRATED CIRCUIT	27014	3-60004	156
A1IC3	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	157
A1IC4	SN7400N	INTEGRATED CIRCUIT	27014	3-60000	158
A1IC5	SN7404N	INTEGRATED CIRCUIT	27014	3-60002	159
A1IC6	SN7400N	INTEGRATED CIRCUIT	27014	3-60000	160
A1IC7	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	161
A1IC8	SN7441N	INTEGRATED CIRCUIT	27014	3-60003	162
A1IC9	SN7475N	INTEGRATED CIRCUIT	27014	3-60004	163
A1IC10	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	164
A1IC11	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	165
A1IC12	SN7441N	INTEGRATED CIRCUIT	27014	3-60003	166
A1IC13	SN7475N	INTEGRATED CIRCUIT	27014	3-60004	167
A1IC14	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	168
A1IC15	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	169
A1IC16	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	170
A1IC17	SN7420N	INTEGRATED CIRCUIT	27014	3-60012	171
A1IC18	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	172
A1IC19	LM309K	INTEGRATED CIRCUIT	27014	3-60007	173
A1IC20	SN7441N	INTEGRATED CIRCUIT	27014	3-60003	174
A1IC21	SN7475N	INTEGRATED CIRCUIT	27014	3-60004	175
A1IC22	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	176
A1IC23	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	177
A1IC24	SN7475N	INTEGRATED CIRCUIT	27014	3-60004	178
A1IC25	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	179
A1IC26	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	180

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8420	8420-700	D	
TITLE		SHT OF	
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** MATCHED SET (IC 42, R126, Q22)

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PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1IC27	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	181
A1IC28	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	182
A1IC29	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	183
A1IC30	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	184
A1IC31	CIC-200-1	INTEGRATED CIRCUIT	16067	3-30134	185
A1IC32	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	186
A1IC33	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	187
A1IC34	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	188
A1IC35	CIC-200-3	INTEGRATED CIRCUIT	16067	3-60006	189
A1IC36	CIC-200-3	INTEGRATED CIRCUIT	16067	3-60006	190
A1IC37	CIC-200-3	INTEGRATED CIRCUIT	16067	3-60006	191
A1IC38	CIC-200-3	INTEGRATED CIRCUIT	16067	3-60006	192
A1IC39	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	193
A1IC40	LM310	INTEGRATED CIRCUIT	27014	3-60011	194
A1IC41	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	195
* A1IC42	CIC-225	INTEGRATED CIRCUIT	16067	3-60008	196
A1IC43	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	197
A1IC44	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	198
A1IC45	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	199
					200
					201
					202
					203
A1J1	AC3	CONN. RECEPTACLE	82389	4-10111	204
					205
					206
					207
					208
A1L1	2500-46	CHOKE 2.4mH	99800	5-90048	209
A1L2	2500-46	CHOKE 2.4mH	99800	5-90048	210
A1L3	1537-90	CHOKE 200μH	99800	5-90005	211
A1L4	1537-90	CHOKE 200μH	99800	5-90005	212
A1L5	1537-90	CHOKE 200μH	99800	5-90005	213
A1L6	1537-90	CHOKE 200μH	99800	5-90005	214
					215
					216

MODEL	CALICO P/N		ASSY R.D.
8420	8420-700	A	
TITLE		SHT OF	
P.C. BOARD ASSY, DIGITAL MULTIMETER		9 15	A1

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PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
					217
					218
					219
A1Q1	CIC-341	TRANSISTOR	16067	3-30184	220
A1Q2	2N2102	TRANSISTOR	95303	3-30075	221
A1Q3	2N4036	TRANSISTOR	95303	3-30106	222
A1Q4	TIS43	TRANSISTOR	01295	3-30131	223
A1Q5	CIC-341	TRANSISTOR	16067	3-30184	224
A1Q6	MJE 340	TRANSISTOR	04713	3-30199	225
A1Q7	MJE 340	TRANSISTOR	04713	3-30199	226
A1Q8	MJE 340	TRANSISTOR	04713	3-30199	227
A1Q9	CIC-341	TRANSISTOR	16067	3-30184	228
A1Q10	CIC-350	TRANSISTOR, FET, DUAL	16067	3-30016	229
A1Q11	U1899E	TRANSISTOR, FET	15818	3-30196	230
A1Q12	U1899E	TRANSISTOR, FET	15818	3-30196	231
A1Q13	U1899E	TRANSISTOR, FET	15818	3-30196	232
A1Q14	U1899E	TRANSISTOR, FET	15818	3-30196	233
A1Q15	CIC-341	TRANSISTOR	16067	3-30184	234
A1Q16	U1899E	TRANSISTOR, FET	15818	3-30196	235
A1Q17	U1899E	TRANSISTOR, FET	15818	3-30196	236
A1Q18	SG 3821 N	TRANSISTOR, ARRAY	0000J	3-30203	237
A1Q19	MJE 340	TRANSISTOR	04713	3-30199	238
A1Q20	U1899E	TRANSISTOR, FET	15818	3-30196	239
A1Q21	CIC-341	TRANSISTOR	16067	3-30184	240
A1Q22	CIC-225	SEE ITEM 196			241
A1Q23	MJE 340	TRANSISTOR	04713	3-30199	242
					243
					244
					245
A1R1	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	246
A1R2	RC07GF302J	RESISTOR 3K 1/4W 5%	81349	5-10063	247
A1R3	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	248
A1R4	BWH 1Ω 5% 2W	RESISTOR 1Ω 2W 5%	07716	5-40001	249
A1R5	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	250
A1R6	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	251
A1R7	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	252

MODEL	CALICO P/N		ASSY R.D.
8420	8420-700	D	
TITLE	P.C. BOARD ASSY, DIGITAL MULTIMETER	SHT 10 OF 15	A1

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PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R8	RC20GF470J	RESISTOR 47Ω 1/2W 5%	81349	5-20013	253
A1R9	RC07GF182J	RESISTOR 1.8K 1/4W 5%	81349	5-10058	254
A1R10	RC07GF182J	RESISTOR 1.8K 1/4W 5%	81349	5-10058	255
A1R11	RC20GF470J	RESISTOR 47Ω 1/2W 5%	81349	5-20013	256
A1R12	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	257
A1R13	RC07GF274J	RESISTOR 270K 1/4W 5%	81349	5-10110	258
A1R14	RC07GF363J	RESISTOR 36K 1/4W 5%	81349	5-10089	259
A1R15	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	260
A1R16	RC07GF201J	RESISTOR 200Ω 1/4W 5%	81349	5-10036	261
A1R17	RC07GF621J	RESISTOR 620Ω 1/4W 5%	81349	5-10048	262
A1R18	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	263
A1R19	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	264
A1R20	RC07GF271J	RESISTOR 270Ω 1/4W 5%	81349	5-10039	265
A1R21	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	266
A1R22	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	267
A1R23	RC07GF150J	RESISTOR 15Ω 1/4W 5%	81349	5-10009	268
A1R24	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	269
A1R25	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	270
A1R26	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	271
A1R27	MK-14	RESISTOR 1.333K 1/8W .1%	17838	5-80158	272
A1R28	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	273
A1R29	RC07GF201J	RESISTOR 200Ω 1/4W 5%	81349	5-10036	274
A1R30	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	275
A1R31	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	276
A1R32	MK-14	RESISTOR 10.000K 1/8W .01%	17838	5-80148	277
A1R33	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	278
A1R34	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	279
A1R35	RCo7GF183J	RESISTOR 18K 1/4W 5%	81349	5-10082	280
A1R36	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	281
A1R37	RC07GF110J	RESISTOR 11Ω 1/4W 5%	81349	5-10006	282
A1R38	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	283
A1R39	RC07GF302J	RESISTOR 3K 1/4W 5%	81349	5-10063	284
A1R40	MK-14	RESISTOR 10K 1/8W .01%	17838	5-80148	285
A1R41	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	286
A1R42	X-201R101	POTENTIOMETER 100Ω	71450	5-70153	287
A1R43	RC07GF512J	RESISTOR 5.1K 1/4W 5%	81349	5-10069	288

MODEL	8420	CALICO P/N	8420-700	A	ASSY R.D.
TITLE	P.C. BOARD ASSY, DIGITAL MULTIMETER	SHT 11	OF 15		A1

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PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R44	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	289
A1R45	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	290
A1R46	RC07GF201J	RESISTOR 200Ω 1/4W 5%	81349	5-10036	291
A1R47	RC07GF242J	RESISTOR 2.4K 1/4W 5%	81349	5-10061	292
A1R48	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	293
A1R49	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	294
A1R50	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	295
A1R51	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	296
A1R52	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	297
A1R53	RC07GF154J	RESISTOR 150K 1/4W 5%	81349	5-10104	298
A1R54	RN60D1503F	RESISTOR 150K 1/4W 1%	81349	5-60446	299
A1R55	RN60D1503F	RESISTOR 150K 1/4W 1%	81349	5-60446	300
A1R56	RC07GF302J	RESISTOR 3K 1/4W 5%	81349	5-10063	301
A1R57	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	302
A1R58	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	303
A1R59	RN60D2003F	RESISTOR 200K 1/4W 1%	81349	5-60147	304
A1R60	RN60D2003F	RESISTOR 200K 1/4W 1%	81349	5-60147	305
A1R61	RC07GF106J	RESISTOR 10M 1/4W 5%	81349	5-10135	306
A1R62	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	307
A1R63	RC07GF133J	RESISTOR 13K 1/4W 5%	81349	5-10079	308
A1R64	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	309
A1R65	RN60D1822F	RESISTOR 18.2K 1/4W 1%	81349	5-60097	310
A1R66	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	311
A1R67	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	312
A1R68	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	313
A1R69	X-201R104	POTENTIOMETER 100K	71450	5-70157	314
A1R70	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	315
A1R71	RC07GF226J	RESISTOR 22M 1/4W 5%	81349	5-10139	316
A1R72	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	317
A1R73	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	318
A1R74	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	319
A1R75	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	320
A1R76	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	321
A1R77	RC07GF392J	RESISTOR 3.9K 1/4W 5%	81349	5-10066	322
A1R78	U39-5Ω	POTENTIOMETER 5Ω	12697	5-70158	323
A1R79	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	324

MODEL	CALICO P/N		ASSY R.D.
8420	8420-700	D	
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PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R80	MK-3H	RESISTOR 8.9725K 1/4W .1%	17838	5-80159	325
A1R81	U39-50Ω	POTENTIOMETER 50Ω	12697	5-70160	326
A1R82	RC07GF103J	RESISTOR 10K 1/4 W 5%	81349	5-10076	327
A1R83	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	328
A1R84	RN60C1003F	RESISTOR 100K 1/8W 1%	81349	5-60131	329
A1R85	X-201R502	POTENTIOMETER 5K	71450	5-70156	330
A1R86	RN65C9093F	RESISTOR 909K 1/4W 1%	81349	5-60447	331
A1R87	RC07GF222J	RESISTOR 2.2K 1/4W 5%	81349	5-10060	332
A1R88	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	333
A1R89	MK-3H	RESISTOR 89.725K 1/4W .1%	17838	5-80160	334
A1R90	RC07GF471J	RESISTOR 470Ω 1/4W 5%	81349	5-10045	335
A1R91	U39-500Ω	POTENTIOMETER 500Ω	12697	5-70161	336
A1R92	RC07GF243J	RESISTOR 24K 1/4W 5%	81349	5-10085	337
A1R93	RC07GF512J	RESISTOR 5.1K 1/4W 5%	81349	5-10069	338
A1R94	RN60C1002F	RESISTOR 10K 1/8W 1%	81349	5-60081	339
A1R95	X-201R501	POTENTIOMETER 500Ω	71450	5-70155	340
A1R96	RN65C1004F	RESISTOR 1M 1/4W 1%	81349	5-60178	341
A1R97	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	342
A1R98	X-201R101	POTENTIOMETER 100Ω	71450	5-70153	343
A1R99	X-201R101	POTENTIOMETER 100Ω	71450	5-70153	344
A1R100	MK-3H	RESISTOR 897.25K 1/4W .1%	17838	5-80161	345
A1R101	U39-5K	POTENTIOMETER 5K	12697	5-70162	346
A1R102	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	347
A1R103	RC07GF243J	RESISTOR 24K 1/4W 5%	81349	5-10085	348
A1R104	RN60C9760F	RESISTOR 976Ω 1/8W 1%	81349	5-60451	349
A1R105	RN60D1000F	RESISTOR 100Ω 1/4W 1%	81349	5-60005	350
A1R106	X-201R101	POTENTIOMETER 100Ω	71450	5-70153	351
A1R107	MF-2-1M-T-2-1%	RESISTOR 1M 2W 1%	91637	5-50191	352
A1R108	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	353
A1R109	MK-9H	RESISTOR 2.9992M 3/4W .1%	17838	5-80162	354
A1R110	MK-9H	RESISTOR 2.9992M 3/4W .1%	17838	5-80162	355
A1R111	MK-9H	RESISTOR 2.9992M 3/4W .1%	17838	5-80162	356
A1R112	MK-14	RESISTOR 50K 1/8W .01%	17838	5-80163	357
A1R113	RC07GF153J	RESISTOR 15K 1/4W 5%	81349	5-10080	358
A1R114	RC07GF752J	RESISTOR 7.5K 1/4W 5%	81349	5-10073	359
A1R115	MK-3H	RESISTOR 997.5Ω 1/4W .1%	17838	5-80164	360

MODEL	CALICO P/N		ASSY R.D.
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PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R116	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	361
A1R117	NOT USED				362
A1R118	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	363
A1R119	MK-14	RESISTOR 50K 1/8W .01%	17838	5-80163	364
A1R120	RC07GF201J	RESISTOR 200Ω 1/4W 5%	81349	5-10036	365
A1R121	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	366
A1R122	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	367
A1R123	RC07GF226J	RESISTOR 22M 1/4W 5%	81349	5-10139	368
A1R124	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	369
A1R125	RC07GF752J	RESISTOR 7.5K 1/4W 5%	81349	5-10073	370
A1R126	CIC-225	SEE ITEM 196			371
A1R127	RN60C6042D	RESISTOR 60.4K 1/8W .5%	81349	5-60433	372
A1R128	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	373
A1R129	RN60C2260F	RESISTOR 226Ω 1/8W 1%	81349	5-60449	374
A1R130	ET34P-500	POTENTIOMETER 50Ω	30983	5-70130	375
A1R131	RN60C6042D	RESISTOR 60.4K 1/8W .5%	81349	5-60433	376
A1R132	RN60C1002F	RESISTOR 10K 1/8W 1%	81349	5-60081	377
A1R133	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	378
A1R134	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	379
A1R135	RN60C1002F	RESISTOR 10K 1/8W 1%	81349	5-60081	380
A1R136	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	381
A1R137	RC07GF203J	RESISTOR 20K 1/4W 5%	81349	5-10083	382
A1R138	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	383
A1R139	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	384
A1R140	MK-14	RESISTOR 5.15K 1/8W .1%	17838	5-80155	385
A1R141	MK-14	RESISTOR 1K 1/8W .1%	17838	5-80154	386
A1R142	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	387
A1R143	RN60C1002F	RESISTOR 10K 1/8W 1%	83149	5-60081	388
A1R144	RC07GF912J	RESISTOR 9.1K 1/4W 5%	81349	5-10075	389
A1R145	RN60D	RESISTOR T.B.D.	81349		390
A1R146	RN60C1001F	RESISTOR 1K 1/8W 1%	81349	5-60342	391
A1R147	X-201R104	POTENTIOMETER 100K	71450	5-70157	392
A1R148	RC07GF471J	RESISTOR 470Ω 1/4W 5%	81349	5-10045	393
A1R149	U39-20Ω	POTENTIOMETER 20Ω	12697	5-70159	394
A1R150	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	395
A1R151	RC07GF471J	RESISTOR 470Ω 1/4W 5%	81349	5-10045	396

MODEL	CALICO P/N		ASSY R.D.
8420	8420-700	D	
TITLE		SHT OF	
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PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R152	RN60C6981F	RESISTOR 6.98K 1/8W 1%	81349	5-60480	397
A1R153	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	398
A1R154	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	399
A1R155	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	400
A1R156	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	401
A1R157	X-201R251	POTENTIOMETER, 250Ω	71450	5-70154	402
A1R158	RC07GF471J	RESISTOR 470Ω 1/4W 5%	81349	5-10045	403
A1R159	RN60C1001F	RESISTOR 1K 1/8W 1%	81349	5-60342	404
A1R160	RN60C1001F	RESISTOR 1K 1/8W 1%	81349	5-60342	405
A1R161	RN60C1001F	RESISTOR 1K 1/8W 1%	81349	5-60342	406
A1R162	RC07GF365J	RESISTOR 3.6M 1/4W 5%	81349	5-10140	407
A1R163	RC07GF392J	RESISTOR 3.9K 1/4W 5%	81349	5-10066	408
A1R164	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	409
A1R165	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	410
A1R166	RC07GF473J	RESISTOR 47K 1/4W 5%	81349	5-10092	411
A1R167	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	412
A1R168	RC07GF225J	RESISTOR 2.2M 1/4W 5%	81349	5-10126	413
A1R169	RC07GF107K	RESISTOR 100M 1/4W 10%	81349	5-10145	414
A1S1	8420-012-1	SWITCH, FUNCTION	16067	2-40430	415
A1S2	46206LF	SWITCH, VOLTAGE	82389	2-40298	416
A1S3	8420-011-1	SWITCH, RANGE	16067	2-40429	417
					418
					419
					420
					421
					422
A1T1	8420-010-1	TRANSFORMER	16067	7-10207	423
					424
					425
					426
					427
					428
A1Y1	CR-18A/U	CRYSTAL 1MHz	13454	3-30135	429
					430
					431
					432

MODEL	CALICO P/N		ASSY R.D.
8420	8420-700	D	
TITLE		SHT OF	
P.C. BOARD ASSY, DIGITAL MULTIMETER		15 15	A1

APPENDIX A

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbook H4-1 and its latest supplement. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbook.

0000A	ElectriCord	Westfield, Pa.
0000B	Tech. Prod. Sales	Sorrento Valley, Ca.
0000C	Jackson Bros.	Waddon, Surrey, England
0000D	Chicago Std. Transformer Co.	Chicago, Ill.
0000E	Use Code #08289	
0000F	Colvern	Santa Monica, Ca.
0000G	Use Code #30983	
0000H	Mial Of Italy c/o Q. C. Components	Los Angeles, Ca.
00141	Pic Design Corp.	E. Rockaway, N. Y.
00544	Metal-Cal Div, Avery Prod. Corp.	Inglewood, Ca.
00656	Aerovox Corporation	New Bedford, Mass.
00779	AMP, Inc.	Harrisburg, Pa.
00853	Sangamo Electric Company	Pickens, S. C.
00866	Goe Eng. Co., Inc.	City of Industry, Ca.
01121	Allen-Bradley Company	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Ca.
01281	TRW Semiconductors, Inc.	Lawndale, Ca.
01295	Texas Instruments, Inc.	Dallas, Tex.
02335	Fairchild Controls Corp.	Hicksville, LI, N. Y.
02660	Amphenol Corporation	Broadview, Ill.
02799	ARCO Capacitors, Inc.	Los Angeles, Ca.
03507	General Electric Company	Syracuse, N. Y.
03508	General Electric Company	Syracuse, N. Y.
03516	General Electric Company	Somersworth, N. H.
03797	Eldema Corporation	Compton, Ca.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N. J.
03911	Clairex Corporation	New York, N. Y.
04009	Arrow-Hart and Hegeman Elec. Co.	Hartford, Ct.
04062	Use Code #02799	
04713	Motorola Semiconductor Prod., Inc.	Phoenix, Ariz.
04963	3-M	St. Paul, Minn.
05276	Pomona Electronics Co., Inc.	Pomona, Ca.
05397	Kemet, Union Carbide Corp.	Cleveland, Ohio
05820	Wakefield Engineering, Inc.	Wakefield, Mass.
06184	Conelco Components	San Bernadino, Ca.
06223	Kooltronic Fan Company	Princeton, N. J.
06229	Electrovert, Incorporated	Mt. Vernon, N. Y.
06514	Stantron, Wyco Metal Products	N. Hollywood, Ca.
06540	Amathom Elect. Hardward	New Rochelle, N. Y.
07088	Kelvin Electric Company	Van Nuys, Ca.
07256	Silicon Transistor Corp.	Garden City, N. Y.
07263	Fairchild Camera and Instr. Corp.	Mt. View, Ca.
07387	Birtcher Corporation	Los Angeles, Ca.
07556	Unitrack, Calabro Plastics	Upper Darby, Pa.
07716	IRC, Incorporated	Burrington, Iowa
08065	Accurate Rubber and Plastics Co.	San Diego, Ca.
08289	Blinn-Delbert Co., Inc.	Pomona, Ca.
08718	Use Code #71468	
08730	Vemaline Products Co.	Franklin Lakes, N. J.
09026	Babcock Electronics Corp.	Costa Mesa, Ca.
09145	Atohm, Technical Industries, Inc.	Burbank, Ca.
09353	C and K Components, Inc.	Newton, Mass.
11432	Diamond Metal Sales	Gardena, Ca.
11815	Cherry Rivet Div., Townsend Co.	Santa Ana, Ca.
12020	Ovenaire, Incorporated	Charlottesville, Va.
12143	Bendix Corporation	Santa Ana, Ca.
12405	Hysol Corporation	El Monte, Ca.
12406	Elpac, Incorporated	Fullerton, Ca.
12463	Omtronics Mfg., Incorporated	Omaha, Neb.
12697	Clarostat Mfg. Co., Incorporated	Dover, N. H.
13103	Thermalloy Company	Dallas, Tex.
13454	Texas Crystals	River Grove, Ill.
14099	Semtech Corporation	Newbury Park, Ca.
14655	Cornell-Dubilier Elect. Corp.	Newark, N. J.
14752	Electro Cube, Incorporated	San Gabriel, Ca.
15112	Electra Scientific Corporation	Fullerton, Ca.
15801	Fenwall Electronics	Framingham, Mass.
15818	Amelco, Teledyne, Incorporated	Mt. View, Ca.
15909	Use Code #17870	
15912	Digital Sensors, Incorporated	Los Angeles, Ca.
16067	Californ's Instruments Company	San Diego, Ca.
16758	Delco Radio Div., General Motors	Kokomo, Ind.
16902	Simpson Instruments, Inc.	Escondido, Ca.
17745	Angstrohm Precision, Inc.	Van Nuys, Ca.
17838	Mektron, California General, Inc.	Chula Vista, Ca.
17870	Daven Div., Thomas A. Edison	Manchester, N. H.
18121	Wilshire Foam Products, Inc.	Gardena, Ca.
18702	Ducommun Metals and Supply Co.	Los Angeles, Ca.
18722	RCA	Mountaintop, Pa.
19080	The Robinson Company	Hawthorne, Ca.
19781	Potter Company	Sun Valley, Ca.
20857	South Bay Cable Corp.	Gardena, Ca.
21604	Buckeye Stamping Company	Columbus, Ohio
22599	Elastic Stop Nut Corporation	Van Nuys, Ca.
23039	Deccofelt Products Company	Glendora, Ca.
23050	Product Components Corp.	Hastings-on-Hudson, N. Y.
23783	British Radio Electric Ltd.	Washington, D. C.
23936	Pamotor, Incorporated	San Francisco, Ca.
24931	Specialty Connector Co., Inc.	Indianapolis, Ind.
25684	Victoreen Instrument Co., Inc.	Oak Lawn, Ill.
25706	Daburn Electronics and Cable Corp.	New York, N. Y.
26528	Lamcor, Incorporated	Anaheim, Ca.
26533	Zero Manufacturing Company	Burbank, Ca.
27014	National Semi-Conductor Corp.	Santa Clara, Ca.
27191	Cutler-Hammer, Inc.	Milwaukee, Wisc.
27556	IMB Electronic Products	Santa Fe Springs, Ca.
80223	United Transformer Co. (Late Entry)	New York, N. Y.
27683	Varo, Incorporated	St. Garland, Tex.
28520	Heyman Mfg. Company (Heyco)	Kenilworth, N. J.
30086	I-T-E Circuit Breaker Co.	Philadelphia, Pa.
30817	Instrument Specialties Co.	Little Falls, N. J.
30983	Electra/Midland	San Diego, Ca.
42190	Muter Company	Chicago, Ill.
44655	Ohmite Manufacturing Company	Skokie, Ill.
45722	Parker-Kalon	Clifton, N. J.
46384	Penn. Eng. and Mfg. Corp.	Doylestown, Pa.
56289	Sprague Electric Company	North Adams, Mass.
58474	Superior Electric Company	Bristol, Ct.
59730	Thomas and Betts Company	Elizabeth, N. J.
60741	Triplett Electrical Instrument Co.	Bluffton, Ohio
63743	Ward Leonard Electric Co.	Mt. Vernon, N. Y.
70903	Belden Manufacturing Co.	Chicago, Ill.
71002	Birnbach Radio Company, Inc.	New York, N. Y.
71279	Cambridge Thermionic Corp.	Cambridge, Mass.
71400	Bussmann Mfg. Div., McGraw-Edison Co.	St. Louis, Mo.
71450	CTS Corporation	Elkhart, Ind.
71468	ITT Cannon Electric, Inc.	Los Angeles, Ca.
71590	Centralab Div., Globe-Union, Inc.	Milwaukee, Wis.
71785	Cinch Manufacturing Company	Chicago, Ill.
72259	Nytronics, Incorporated	Berkeley Heights, N. J.
72619	Dialight Corporation	Brooklyn, N. Y.
72982	Erie Technological Products, Inc.	Erie, Pa.
73138	Beckman Instruments, Inc.	Fullerton, Ca.
73559	Carling Electric, Inc.	West Hartford, Ct.
73734	Federal Screw Products, Inc.	Chicago, Ill.
73899	JFD Electronics Company	Brooklyn, N. Y.
73949	Guardian Electric Mfg. Co.	Chicago, Ill.
73957	Groov-Pin Corporation	Ridgefield, N. J.
74193	Heinemann Electric Company	Trenton, N. J.
74276	Signalite, Incorporated	Neptune, N. J.
74542	Hoyt Electrical Instrument Works	Penacook, N. H.
74545	Harvey Hubbell, Inc.	Bridgeport, Ct.
74970	E. F. Johnson Company	Waseca, Minn.
75382	Kulka Electric Corporation	Mt. Vernon, N. Y.
75915	Littelfuse, Incorporated	Des Plaines, Ill.
75987	Use Code #95987	
76055	Mallory Controls	Frankfort, Ind.
76348	Miller Products Company	New York, N. Y.
76493	J. W. Miller Company	Los Angeles, Ca.
76854	Oak Manufacturing Company	Crystal Lake, Ill.
77342	Potter and Brumfield Div., Amer. Machine and Foundry Company	E. Princeton, Ind.
78189	Shakeproof Div., Illom's Tool Works	Chicago, Ill.
78299	Struthers-Dunn, Incorporated	Pitman, N. J.
78488	Stackpole Carbon Company	St. Marys, Pa.
78526	Stanwyck Winding Company, Inc.	Newburgh, N. Y.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78947	Ucinite Company	Newtonville, Mass.
79130	Johns-Manville Products Corp.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Phila., Pa.
79963	Zierick Mfg. Corporation	New Rochelle, N. Y.
80112	G. C. Electronics Company	Los Angeles, Ca.
80294	Bourns, Incorporated	Riverside, Ca.
80368	Sylvania Electric Products, Inc.	New York, N. Y.
81073	Grayhill, Incorporated	La Grange, Ill.
81095	Triad Transformer Corp.	Venice, Ca.
81312	Winchester Electronics	Oakville, Ct.
81349	Military Specs., Standardization Division, Directorate of Logistic Services DSA	
82389	Switchcraft, Incorporated	Chicago, Ill.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N. Y.
83058	Car Fastener Company	Cambridge, Mass.
83324	Rosan, Incorporated	Newport Beach, Ca.
83330	Herman H. Smith, Inc.	Brooklyn, N. Y.
83594	Burroughs Corporation	Plainfield, N. J.
83701	Electronic Devices, Incorporated	Yonkers, N. Y.
84171	Arco Electronics, Inc.	Great Neck, N. Y.
86684	RCA	Harrison, N. J.
87034	Marco-Oak Industries	Anaheim, Ca.
88026	Use Code #27191	
88245	Useco Div., Litton Industries	Van Nuys, Ca.
90201	Mallory Capacitor Company	Indianapolis, Ind.
91637	Dale Electronics, Inc.	Columbus, Neb.
91662	Elco Corporation	Willow Grove, Pa.
91812	Janco Corporation	Burbank, Ca.
91833	Keystone Electronics Corp.	New York, N. Y.
91929	Micro Switch Div., Honeywell, Inc.	Freeport, Ill.
92194	Alpha Wire Corporation	Elizabeth, N. J.
92219	Waldom Electronics, Inc.	Chicago, Ill.
93332	Sylvania Electric Products, Inc.	Woburn, Mass.
94222	Southco, Incorporated	Lester, Pa.
95146	Alco Electronics Products	Lawrence, Mass.
95303	RCA	Cincinnati, Ohio
95416	Use Code #95146	
95987	Weckesser Company, Inc.	Chicago, Ill.
96682	Genisco, Incorporated	Compton, Ca.
97954	U. S. Components, Incorporated	Bronx, N. Y.
98159	Rubber Teck, Incorporated	Gardena, Ca.
98278	Microdot, Incorporated (Lerco)	S. Pasadena, Ca.
98978	IERC	Burbank, Ca.
99392	STM Corporation	Oakland, Ca.
99515	Marshall Industries	Monrovia, Ca.
99517	Vacco Industries	El Monte, Ca.
99800	Delevan Electronics Corporation	Aurora, N. Y.

ONE YEAR WARRANTY

CALIFORNIA INSTRUMENTS COMPANY a division of AIKEN INDUSTRIES INC. warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Excepted from this warranty are tubes, fuses, and batteries which carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS COMPANY will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned to the Company freight prepaid, and when examination reveals that the fault has not occurred because of misuse or abnormal conditions of operation. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALIFORNIA INSTRUMENTS COMPANY will submit an estimate for such charges before commencing repair if so requested.

PROCEDURE FOR SERVICE

If a fault develops, notify CALIFORNIA INSTRUMENTS COMPANY or its local representative, giving full details of the difficulty, and including the model number and serial number. On receipt of this information, service data or shipping instructions will be furnished. If shipment is indicated, forward the instrument, freight prepaid, to the authorized repair station indicated in the instruction. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.

DAMAGE IN TRANSIT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. CALIFORNIA INSTRUMENTS COMPANY will advise the disposition to be made of the equipment and arrange for repair or replacement. Please include model number and serial number when referring to the instrument.

H/R E0301
LCWSL NAD B 64
LAQUELLETTE LC022
6252745385
GMT
BLDG. 64

SERIES 815T

PRECISION

OSCILLATOR

815T-400-.1-2Φ

behlman division
CALIFORNIA INSTRUMENTS COMPANY
a division of AIKEN INDUSTRIES, INC.
5150 CONVOY STREET | SAN DIEGO, CA 92111 714–279–8620 CABLE: CALICO SAN DIEGO

T-4

CALIFORNIA INSTRUMENTS COMPANY
San Diego, California 92111

Original
August 1971
Behlman

INSTRUCTION MANUAL

SERIES 815T

PRECISION

OSCILLATOR

815T-400-.1-2Ø

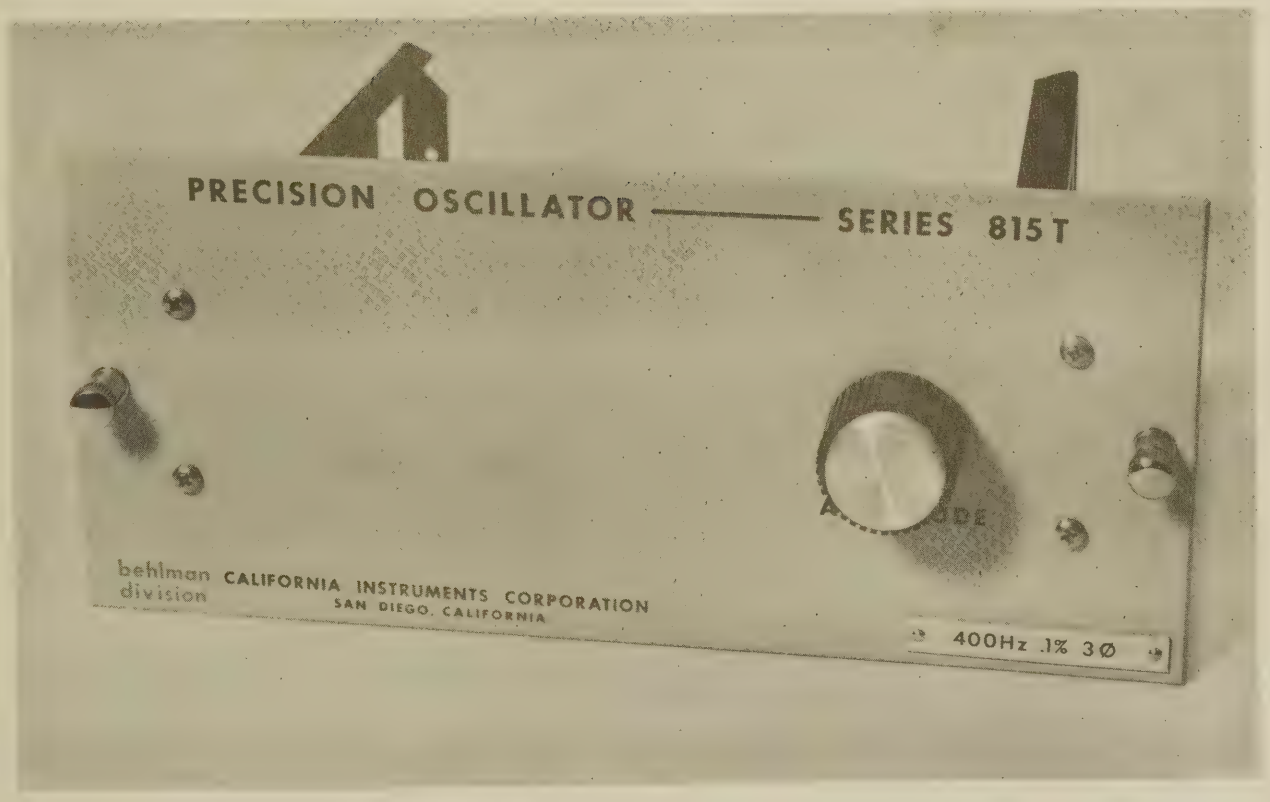

FIGURE 1-1

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ASSEMBLY REFERENCE DESIGNATOR	DRAWING NUMBER	TITLE
None	4815-400	UNIT ASSEMBLY
	4815-070	INTERCONNECTING DIAGRAM
A1	4815-700	BASIC OSCILLATOR ASSEMBLY
	4815-071	BASIC OSCILLATOR SCHEMATIC
A2	4800-701	SINGLE PHASE TO MULTIPHASE CONVERTER ASSEMBLY
	4800-072	SINGLE PHASE TO MULTIPHASE CONVERTER SCHEMATIC

MANUAL ADDENDUM

MODEL [illegible]

The Model [illegible] provides a two phase 400 Hz ±0.1% output to drive a Behlman Solid State Invertron™.

[illegible] the frequency determining parts list for component values which change with operating frequency.

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A CODE LIST OF MANUFACTURERS

SPECIFICATIONS

All specifications are tested in accordance with standard Behlman test procedures. All specifications apply over the frequency range from 45Hz to 10Hz. Consult the manual addendum for the actual oscillator output frequency.

MODEL NUMBER:	815T-Freq-.1-1	815T-Freq-.1-3*	815T-Freq-.1-2
No. of Phases:	single phase	three phase	two phase
Nominal Phase Shift:	Not applicable	120 degrees	90 degrees
Phase Sequence:	Not applicable	ABC sequence	CA sequence
Amplitude Tracking:	Not applicable	2.0 per cent as measured with amplitude potentiometer fully clockwise	2.0 per cent measured with amplitude potentiometer fully clockwise
Phase Accuracy at 25°C:	Not applicable	±2 degrees maximum as measured with amplitude potentiometer fully clockwise	±2 degrees maximum as measured with amplitude potentiometer fully clockwise

SPECIFICATIONS COMMON TO ALL MODELS

Frequency:	Single Fixed Frequency, 45Hz to 10KHz.
Frequency Accuracy at 25°C:	±0.10 per cent.
Frequency Temperature Coefficient:	±.02 per cent/°C maximum
Output Amplitude:	5.0 volts rms minimum for single phase versions; 0 to greater than 5 volts rms for multiphase versions.
Amplitude Stability: (after one hour warm-up)	±0.25 per cent for 24 hours at 25°C ±0.02 per cent/°C maximum
Total Harmonic Distortion:	0.2 per cent maximum

Input Power:	±25 volts DC at approximately 18 milliamperes available from power source for single phase versions: ±25 volts DC at approximately 55 milliamperes available from power source for three phase versions.
Operating Temperature Range:	0 to 55°C for all versions.
Dimensions:	3-1/2" high x 8" wide x 7" deep for mounting to a Behlman Solid State Invertron®.
Front Panel Finish:	Grey 26440. Federal Standard 595.

* Order Model 815T-Freq-.1-3D for use in the three phase open delta configuration.

GENERAL DESCRIPTION

1.1 INTRODUCTION

This instruction manual contains information on the installation, operation, calibration and maintenance of the Behlman 815T Series Precision Oscillators. A detailed theory of operation is provided as an aid to maintenance personnel. A complete parts listing, schematics and component location drawings are also supplied.

1.2 MODEL NUMBER DESCRIPTION

All oscillators in the 815T Series have a four or five place model munber which describes the following features: the oscillator series, the output frequency of the oscillator, the frequency tolerance of the oscillator, and the number of phases of the oscillator. In addition, a "D" is placed after the model number if the oscillator is to be used in the three phase, open delta configuration. The following examples illustrate this numbering system.

Example 1: 815T-400-0.1-3ϕ

This is a 400 Hz, three phase oscillator with a specified frequency accuracy ±0.1%

Example 2: 815T-50-0.1-3ϕD

This is a 50 Hz, three phase oscillator for use in the open delta configuration with a specified frequency accuracy of ±0.1%.

1.3 GENERAL DESCRIPTION

The Behlman 815T Series Oscillators provide a pure sine wave output for driving the Behlman Solid State Invertrons.® This oscillator incorporates a unique F.E.T. amplitude regulator circuit.

The multi-phase versions of the 815T Series Oscillators are used to drive two or more Solid State Invertrons® connected so as to provide either two phase or three phase power.

1.4 ACCESSORY EQUIPMENT

The following equipment is available for use with the 815T Series Oscillators.

1.4.1 4800-703 Extender Assembly. This assembly allows the oscillator to be tested and adjusted outside of the associated Solid State Invertron®.

CAUTION

HIGH VOLTAGE

Voltages up to 500 VAC are available in certain associated Invertrons®. This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with connector pins C and D of the plug in oscillator, the primary power circuits, and output circuits of the associated Invertron® if oscillator is tested and adjusted with Invertron®.

INSTALLATION AND OPERATION

2.1 UNPACKING

Individual oscillators are shipped in a cardboard container with protective inner packing. Do not destroy this packing container until the unit has been inspected for possible damage in shipment.

2.2 POWER REQUIREMENTS

Single phase versions of the Behlman 815T Oscillator operate from plus (+) and minus (-) 25 volts DC at 0.018 amperes. This power is normally obtained from the associated Invertron.® Three phase versions of the 815T Oscillator require approximately 55 milliamperes at ± 25 volts D. C.

2.3 FUSE REQUIREMENTS

No separate fuse is required with the Behlman 815T Series Precision Oscillators.

2.4 ACCEPTANCE TEST PROCEDURE

Inspect the unit for any possible shipping damage immediately upon receipt. If damage is evident, notify the carrier. DO NOT return an instrument to the factory without prior approval. If the unit appears in good condition, perform the following:

Mount the oscillator in the appropriate rack housing or otherwise apply ± 25 volt DC power to the unit.

2.4.1 MODEL 815T-Freq-Tol-1ϕ FIXED FREQUENCY OSCILLATOR

Figure 5-1 shows a test circuit for the 815T Series Oscillators. The output of this single phase oscillator should be 5.0 volts rms minimum. Connect an oscilloscope to the output of the oscillator and check that the oscillator has a clean sine wave output with no clipping or other distortion. Check that the output frequency is within 0.1 per cent of that indicated in the manual addendum. Detailed test procedures are given in the TEST PROCEDURE of this manual if futher evaluation of the oscillator is required at this time.

2.4.2 MODEL 815T-Freq-Tol-3ϕ FIXED FREQUENCY OSCILLATOR

The output of this three phase oscillator is controlled by the front panel AMPLITUDE control. Rotate this control fully clockwise. The output amplitude of each phase of the oscillator should be at least 5 volts rms. See Figure 5-1 for a detailed test circuit.

Connect an oscilloscope to the output of the oscillator and check that each phase of the oscillator has a clean sine wave output with no clipping or other distortion. Check that the output frequency is within 0.1 per cent of that indicated in the manual addendum. Detailed test procedures are given in the TEST PROCEDURE of this manual if further evaluation of the oscillator is required at this time.

2.4.3 MODEL 815T-Freq-Tol-2ϕ FIXED FREQUENCY OSCILLATOR

The output of this two phase oscillator is controlled by the front panel AMPLITUDE control. Rotate this control fully clockwise. The output amplitude of each phase of the oscillator should be at least 5 volts rms. See Figure 5-1 for a detailed test circuit.

Connect the oscilloscope to the output of the oscillator and check that both phases of the oscillator have a clean sine wave output with no clipping or other distortion. Check that the output frequency is within 0.1 per cent of that indicated in the manual addendum. Detailed test procedures are given in the TEST PROCEDURE of this manual if further evaluation of the oscillator is required at this time.

2.5 MECHANICAL INSTALLATION AND WIRING

The 815T Series Precision Oscillators fit directly into the Behlman Solid State Invertron® Series of power amplifiers. All power for the oscillator, as well as signal output, is coupled through the printed circuit connector at the rear of the oscillator. The following table lists the voltage and applicable connector pins.

Pin	Function	
1	Output signal low	Phase A
2	Output signal high	Phase A
3	Power Ground	
4	+25 volt input	
5	-25 volt input	
6	Output signal low	Phase B
7	Output signal high	Phase B
8	Output signal low	Phase C
9	Output signal high	Phase C
10	External sync input	
C	115 volts AC line high	
D	115 volts AC line low	

The single phase version of the 815T Series Oscillator only has an "A" phase output. The two phase version of the 815T Series Oscillator has an "A" and "C" phase output while the three phase version of this oscillator has all three outputs. The external sync input and 115 volt AC inputs are not used for the standard versions of this oscillator.

2.6 OPERATING CONTROLS

Single phase versions of the 815T oscillator have no front panel operating controls. Multiphase versions of this oscillator have an AMPLITUDE control which is used to vary the output voltage level of all phases of the oscillator from 0 volts to greater than 5.0 volts rms.

In a multiphase power source, the GAIN control on each of the associated power amplifiers is used as a trim control to adjust each of the output leg voltages so that they are precisely equal to each other.

CAUTION

REMOVE POWER FROM
BEHLMAN SOLID STATE
INVERTRON® BEFORE
REMOVING OR INSERTING
PLUG-IN OSCILLATOR

THEORY OF OPERATION

3.1 DESCRIPTION OF SINGLE PHASE OSCILLATOR

A block diagram for the basic single phase oscillator in the 815T Series is given in Figure 3-1. A schematic diagram for the oscillator printed circuit board (designated as the A1 Assembly) is given in drawing D4815-071. An inner connecting wiring diagram is given in drawing D4815-070 for single phase, two phase and three phase versions of this oscillator.

The frequency determining elements are arranged in a Wien bridge configuration which is connected as a positive feedback loop around an operational amplifier as illustrated in Figure 3-1. The frequency of oscillation f_o is given by the equation,

$$f_o = \frac{1}{2\pi RC}$$

where R is the total resistance in the positive feedback path and C is the total capacitance in the positive feedback path. At the frequency of oscillation f_o, the positive feedback loop has a transmission of 0.333 and a zero phase shift. The negative feedback loop must adjust the closed loop gain of the operational amplifier A1IC1 to exactly 3.00 in order for the Wien bridge oscillator to produce a pure sine wave output with a minimum of distortion. This is accomplished by means of a servo feedback loop consisting of the level detector, a DC amplifier and the amplitude regulator. Whenverer there is a change in the amplitude of the oscillator, a correction signal appears at the output of the level detector circuit. This correction signal is amplified by the DC amplifier and applied to control the output impedance of the amplitude regulator. The output impedance of the amplitude regulator controls the closed loop gain of the operational amplifier A1IC1. Therefore, any variation in the output of the oscillator is corrected by this servo feedback. The detailed circuit description is given in Section 3.1.1.

3.1.1 DETAILED CIRCUIT OPERATION

A schematic diagram for the single phase oscillator is shown in drawing D4815-071. All components of this oscillator are mounted on circuit board 4815-700, designated as the A1 assembly.

3.1.1.1 LEVEL DETECTOR

The level detector consists of A1R13, A1R14, diodes A1CR3, A1CR4, A1CR1, A1CR2, transistor A1Q3 and capacitor A1C9. The series connected reference elements diodes A1CR3, A1CR4 and base-emitter diode of A1Q3 act so as to set the level of the oscillator output. Diode A1CR3 and A1CR4 conduct on the positive peak of the sine wave output and inject a current pulse into the emitter of A1Q3. The average value of this current pulse is approximately 1.6 microamperes DC when the oscillator has a 5.5 volt rms output at A1 pin 15.

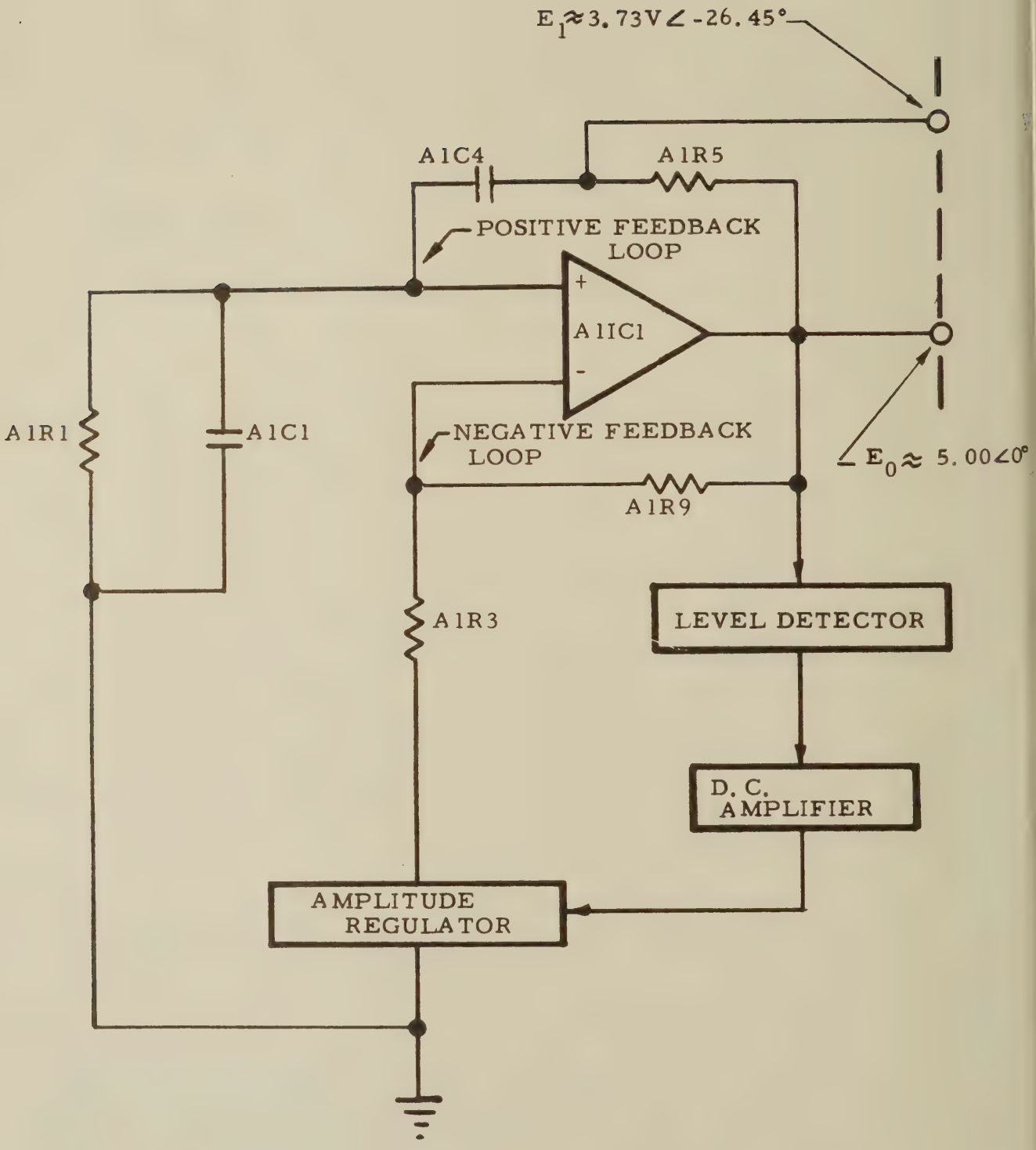


FIGURE 3-1. Block diagram of basic Wien Bridge Oscillator employed in 815T Series Oscillator.

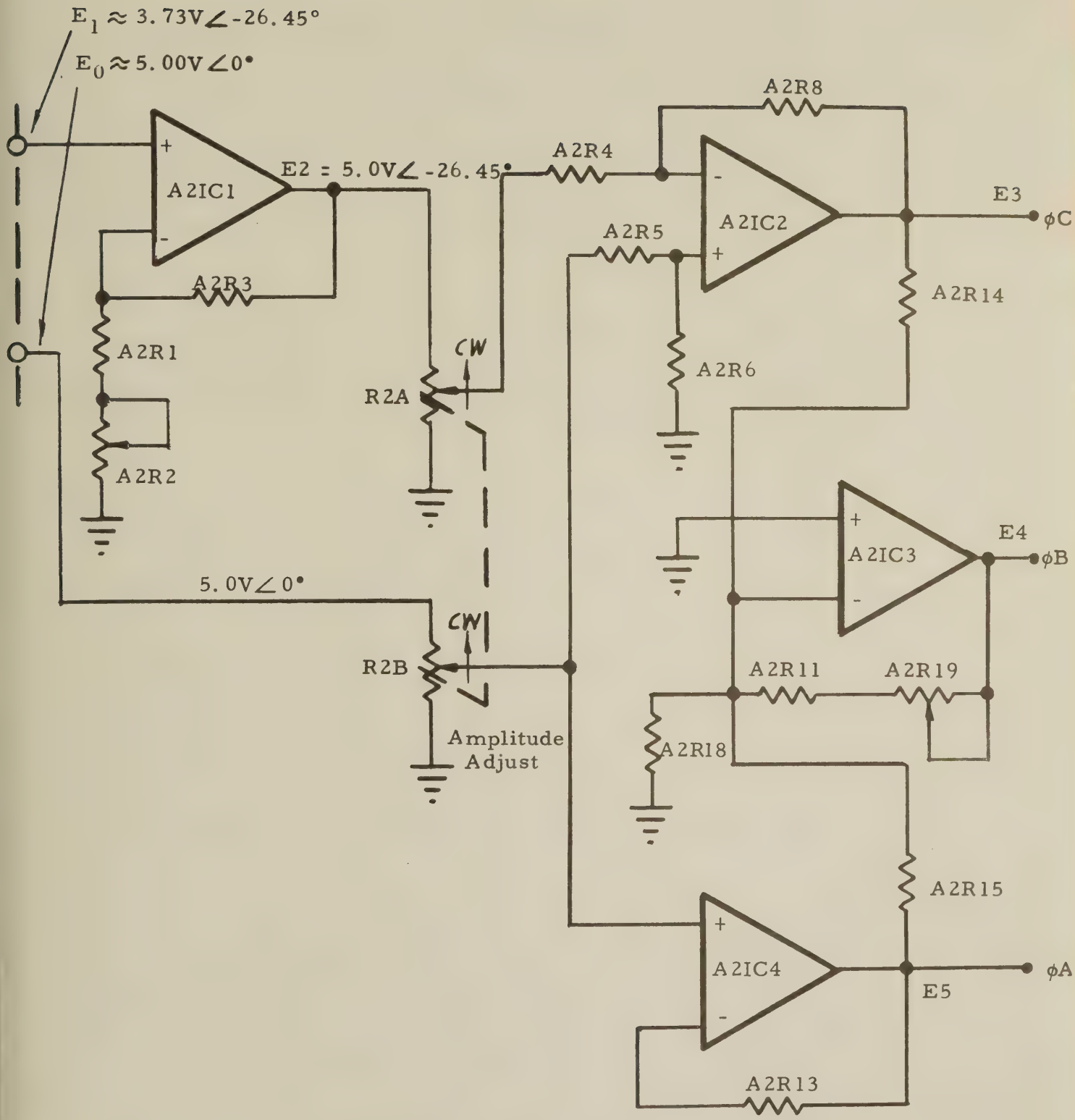


FIGURE 3-2. Block Diagram of Single to Multiphase Converter employed in 815T Series Oscillator.

This current pulse appears in the collector circuit of A1Q3 where it is filtered by capacitor A1C9 to form a DC level across the load circuit, A1R13 in series with A1CR1 and A1CR2. Any variation in the amplitude of the oscillator output will produce a change in the voltage drop across A1C9.

The level detector circuit is temperature compensated by selecting a zener diode A1CR4 with a positive temperature coefficient so as to cancel the negative temperature coefficients of diode A1CR3 and the emitter-base junction of transistor A1Q3.

3.1.1.2 DC AMPLIFIER

Transistor A1Q2 and associated components are connected so as to form a DC amplifier with a small signal gain of approximately five. The signal across A1C9 is amplified and level-shifted for application to the gate of A1Q1.

3.1.1.3 AMPLITUDE REGULATOR

Field effect transistor A1Q1 is connected so as to form an amplitude regulator. The bias at the gate of A1Q1 controls the output impedance (channel resistance) of the amplitude regulator. This output impedance, in turn, controls the closed loop gain of the operational amplifier, A1IC1.

If the sine wave output of the Wien bridge oscillator increases for any reason, the voltage drop across A1C9 also increases, which provides additional base drive to A1Q2. This causes the collector current of A1Q2 to increase and to cause the gate of A1Q1 to be biased more negatively. When the gate of A1Q1 is driven more negatively, the channel resistance of A1Q1 increases. This increase in channel resistance causes the closed loop gain of the operational amplifier A1IC1 to decrease, which in turn decreases the output amplitude of the Wien bridge oscillator and returns it to its original value.

3.2.1 POWER SUPPLY REGULATORS

The power supply regulators allow the oscillator to operate from the unregulated ± 25 volt DC power supply in all Behlman solid state Invertron® power sources. The oscillator requires ±18 to ± 55 milliamperes with less than 2 volts of peak-to-peak ripple at the input to the regulator. The output of the regulators is ±15 volts ±10 per cent with less than 150 millivolts peak-to-peak ripple.

3.2 GENERAL DESCRIPTION OF SINGLE PHASE TO MULTI-PHASE CONVERTER

A block diagram for the single phase to multi-phase converter is given in Figure 3-2. This circuit employs an analog computer technique of generating the second and third phases of the multi-phase

output. This technique requires no additional tuned circuits and provides the required phase shift independent of oscillator frequency.

The operation of this circuit is dependent on the signal E1 which is available at the junction of the resistive and capacitive elements in the positive feedback loop of the Wien bridge oscillator. A detailed analysis of the basic Wien bridge circuit configuration reveals that the voltage E1 at the frequency of the oscillation f_o is given by:

$$E1 = 0.746\ E0 \angle -26.45°$$

The above equation is valid regardless of the frequency of oscillation. Therefore, it is not necessary to vary these circuit parameters as the frequency oscillator is shifted.

The voltages, E0 and E1, are then processed through a sequence of operational amplifiers to provide the phase "A", phase "B" and phase "C" outputs. The vector diagram below describes how this is accomplished in graphical terms with the AMPLITUDE potentiometer R2 in the fully clockwise position.

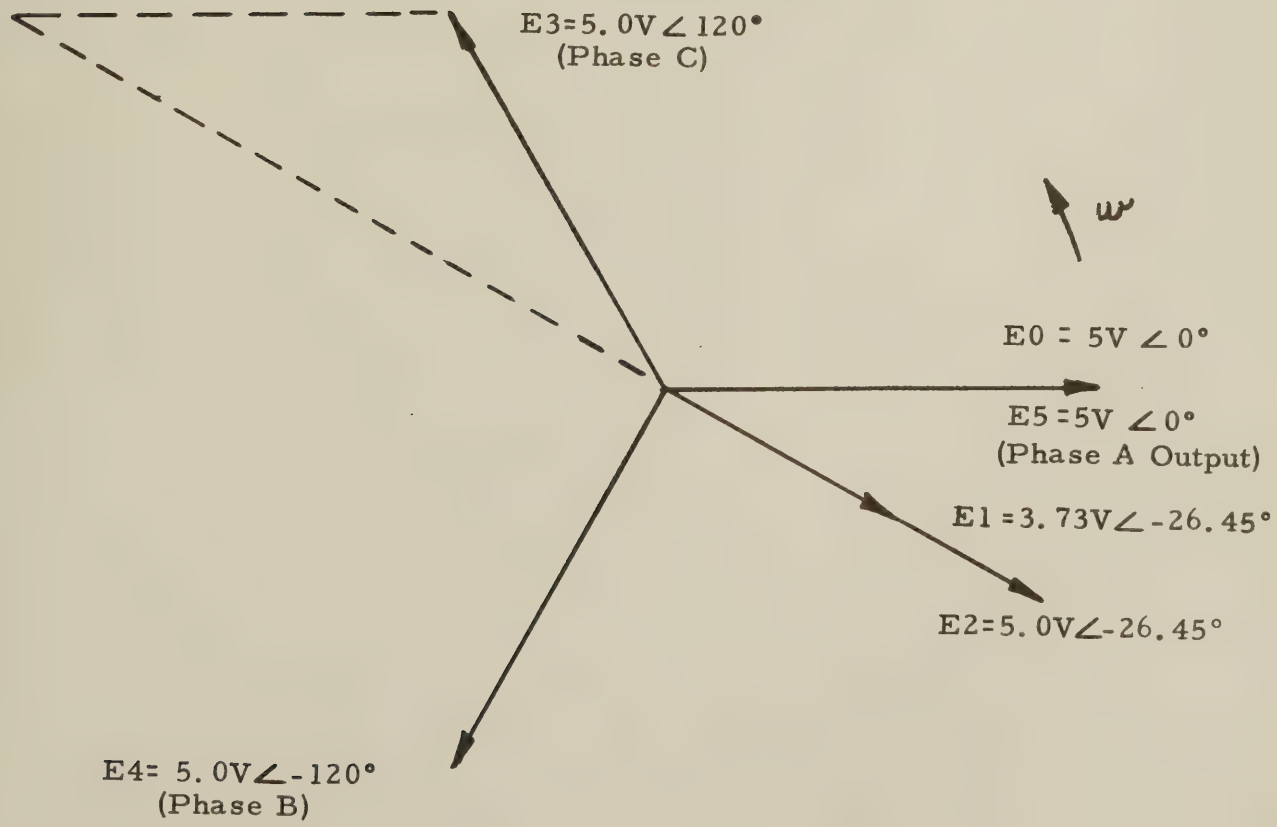


FIGURE 3-3. Vector Diagram for Generation of three-phase Output

First E1 is amplified by a factor of 1.34 to generate E2 at the output of A2IC1. Then E2 is inverted and amplified by a factor of -1.94 by means of the inverting input to A2IC2. The output of the Wien bridge is amplified by a factor of 1.24 with the non-inverting input to A2IC2. The resultant output from A2IC2 provides an E3 (or phase "C") output.

Then E0 is processed through a voltage follower to provide an E5 (or phase "A") output at the output of A2IC4.

Finally, E3 and E5 are added algebraically and then inverted to provide an E4 (or phase "B") output at the output of A2IC3.

For two phase operation, the gain of A2IC2, referenced to the E2 and E0 signals, is changed to -2.245 and 2.01 respectively. This provides a 90 degree phase lead for the phase "C" signal when referenced to the phase "A" signal. The phase "B" signal is not used in this application of the oscillator. For three phase open delta operation, the gain of A2IC2, referenced to the E2 and E0 signals, is changed to -1.94 and 2.24 respectively. This provides a 60 degree phase lead for the phase "C" signal when referenced to the phase "A" signal. The phase "B" signal is not used in this application of the oscillator.

CAUTION

HIGH VOLTAGE (115 AC)

Voltages up to 500VAC are available in certain associated Invertrons®. This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with connector pins C and D of the plug in oscillator, the primary power circuits, and output circuits of the associated Inventron® if oscillator is tested and adjusted with Invertron®.

ADJUSTMENT PROCEDURE

4.1 GENERAL

The following adjustment procedure, or any part of it, may be performed on a routine basis to insure that the oscillator remains within the specified performance limits. This procedure should always be followed after any service to the basic oscillator circuitry.

The adjustment procedure is divided into two sections. These are:

1) Adjustment procedure for Wien bridge oscillator.
2) Phase adjustments for single phase to multiphase converter.

4.2 TEST EQUIPMENT REQUIRED

The following test equipment is required to perform the adjustment procedure.

a) Oscilloscope, Tektronix 531A with general purpose plug-in or equivalent.

b) Behlman Power Source or two H.P. 721A DC Power Supplies or equivalent.

c) Distortion Analyzer, H.P. H02-330B or equivalent.

d) Differential Voltmeter, Fluke 883A or equivalent.

e) Frequency Meter, H.P. 523CR or equivalent.

f) Differential phase meter, DRANETZ 301 or equivalent.

4.3 ADJUSTMENT PROCEDURE FOR WIEN BRIDGE OSCILLATOR

Connect the precision oscillator as shown in Figure 5-1 using either the ±25 volt power supply in the Behlman Solid State Invertron® or a pair of external +25 volt and -25 volt DC power supplies. Each power supply should draw from 18 to 55 milliamperes. Allow the unit to warm up for one half hour.

4.3.1 Starting with potentiometers A1R2, A1R4 and A1R10, in a fully counter clock wise position, rotate A1R4 slowly in the clockwise direction until the oscillator output just builds up to full output. Rotating A1R4 too far clockwise will cause excessive distortion in the output wave form.

4.3.2 After determining the basic frequency and frequency accuracy of the oscillator from the manual addendum, set the basic Wien bridge oscillator frequency by rotating A1R2 and A1R10 equal amounts in the clockwise direction. The frequency may be monitored with the counter at the integrated circuit A1IC1 pin 6 or at the phase "A" output. The potentiometers A1R2 and A1R10 have sufficient resolution to allow the frequency to be set within 0.05 per cent.

4.3.3 Measure the output amplitude and distortion of the Wien bridge oscillator at the phase "A" output with the differential voltmeter and distortion analyzer. The output amplitude should be between 5 volts and 6 volts rms. The distortion should be less than 0.2 percent. If the phase "A" distortion is excessive, or if the oscillator will not start in a reliable fashion when DC power is applied to the oscillator, perform step 4.3.4 below.

4.3.4 Rotate A1R4 counter clockwise until the output amplitude drops by 1 to 5 percent. Then rotate A1R2 and A1R10 slightly in opposite directions until a peak in the output amplitude is obtained while maintaining the correct output frequency. Reset A1R4 so that the oscillator starts in a reliable fashion when DC power is applied to the oscillator and that the distortion is less than 0.2 per cent.

4.4 PHASE ADJUSTMENTS FOR MODEL 815T-Freq-Tol-2ϕ TWO PHASE OSCILLATOR

4.4.1 Connect the Model 815T-Freq-Tol-2ϕ Oscillator as shown in Figure 5-1 using either the ± 25 volt DC supplies in the Behlman Invertron® or a pair of external ± 25 volt DC power supplies. Check that the procedure given in Section 4.3.1 through 4.3.4 of this instruction manual has been performed before proceeding further.

4.4.2 Rotate the front panel AMPLITUDE control fully clockwise. Connect a differential phase meter from the junction of A1R11 and A1R14 to the junction of A2R17 and A2R3. The phase shift must be -26.45 degrees ±0.25 degrees. Parameter unbalance in the basic wien bridge feedback circuit can cause errors in this phase shift.

4.4.3 Adjust potentiometer A2R2 so that the amplitude of the AC voltage at the junction of A2R3 and A2R17 is equal to the voltage measured at the junction of A1R11 and A1R14.

4.4.4 Monitor the phase "A" output of the oscillator with the differential voltmeter and record the AC output voltage.

4.4.5 Monitor the phase "C" output of the oscillator with the differential voltmeter and record the AC output voltage. The amplitude of the phase "A" and phase "C" output voltages should now correspond within 100 millivolts rms of one another.

4.4.6 Connect the differential phase meter from the phase "A" output to the phase "C" output. Readjust potentiometer A2R2 slightly so that the phase "C" output leads the phase "A" output by 90 degrees ±2 degrees and that the amplitude of the phase "A" and phase "C" outputs are within 50 millivolts rms of one another.

4.4.7 Capacitors A2C9 and A2C11 have been installed in the factory for improved phase shift characteristics on certain high-frequency versions of the 815T Series Oscillator.

4.5 PHASE ADJUSTMENTS FOR MODEL 815T-Freq-Tol-3φD THREE PHASE, OPEN DELTA OSCILLATOR

4.5.1 Connect the 815T-Freq-Tol-3φD oscillator as shown in Figure 5-1 and repeat step 4.4.1 through 4.4.7, except check that the phase shift is 60 degrees ±2 degrees.

4.6 PHASE ADJUSTMENTS FOR MODEL 815T-Freq-Tol-3φ THREE PHASE OSCILLATOR

4.6.1 Connect the 815T-Freq-Tol-3φ oscillator as shown in Figure 5-1 and repeat steps 4.4.1 through 4.4.7 except check that the phase shift if 120 degrees ±2 degrees.

4.6.2 Adjust A2R19 so that the phase "B" output amplitude is equal to the phase "A" output amplitude within 50 millivolts rms.

TEST PROCEDURE

5.1 GENERAL

The following test procedure may be performed on a routine basis to insure that the 815T Series Oscillator remains within the specified performance limits. This test procedure is divided into several sections. These are:

1) Output voltage and amplitude stability

2) Harmonic distortion

3) Output frequency and frequency stability

4) Phase accuracy

5.2 TEST EQUIPMENT REQUIRED

The same test equipment is required for the test procedure as was required for the adjustment procedure as given in Section 4.2 of this manual.

5.3 OUTPUT VOLTAGE AND AMPLITUDE STABILITY

5.3.1 Connect the variable frequency oscillator as shown in Figure 5-1 and allow the unit to warm up for one hour in a 25°C environment. In the case of a multiphase oscillator, rotate the AMPLITUDE control fully clockwise.

5.3.2 The output of the oscillator should be measured with differential voltmeter connected to the phase "A" output (Pin 1 and Pin 2 of the printed circuit connector). The output voltage should be between 5.0 volts rms and 6.0 volts rms. Record the exact value of the output voltage.

5.3.3 Measure the phase "A" output voltage in 15 minute increments for two hours. The change in output voltage must not exceed ± 12.5 millivolts rms. This test may be continued for 24 hours if required. Maintain the ambient temperature at 25°C for this test.

5.3.4 Increase the ambient temperature to 50°C and allow the unit to stabilize for one hour. The output should change less than ±25 millivolts rms.

5.4 HARMONIC DISTORTION

Connect the precision oscillator as shown in Figure 5-1 and allow the unit to warm up for a few minutes. In the case of the multiphase oscillators, turn the AMPLITUDE control so that the output from each phase is approximately 5.0 volts rms.

5.4.1 Connect the distortion analyzer between the high output of phase "A" and the ground of phase "A". The distortion should be less than 0.2 per cent if the oscillator frequency is between 45 Hz and 10KHz.

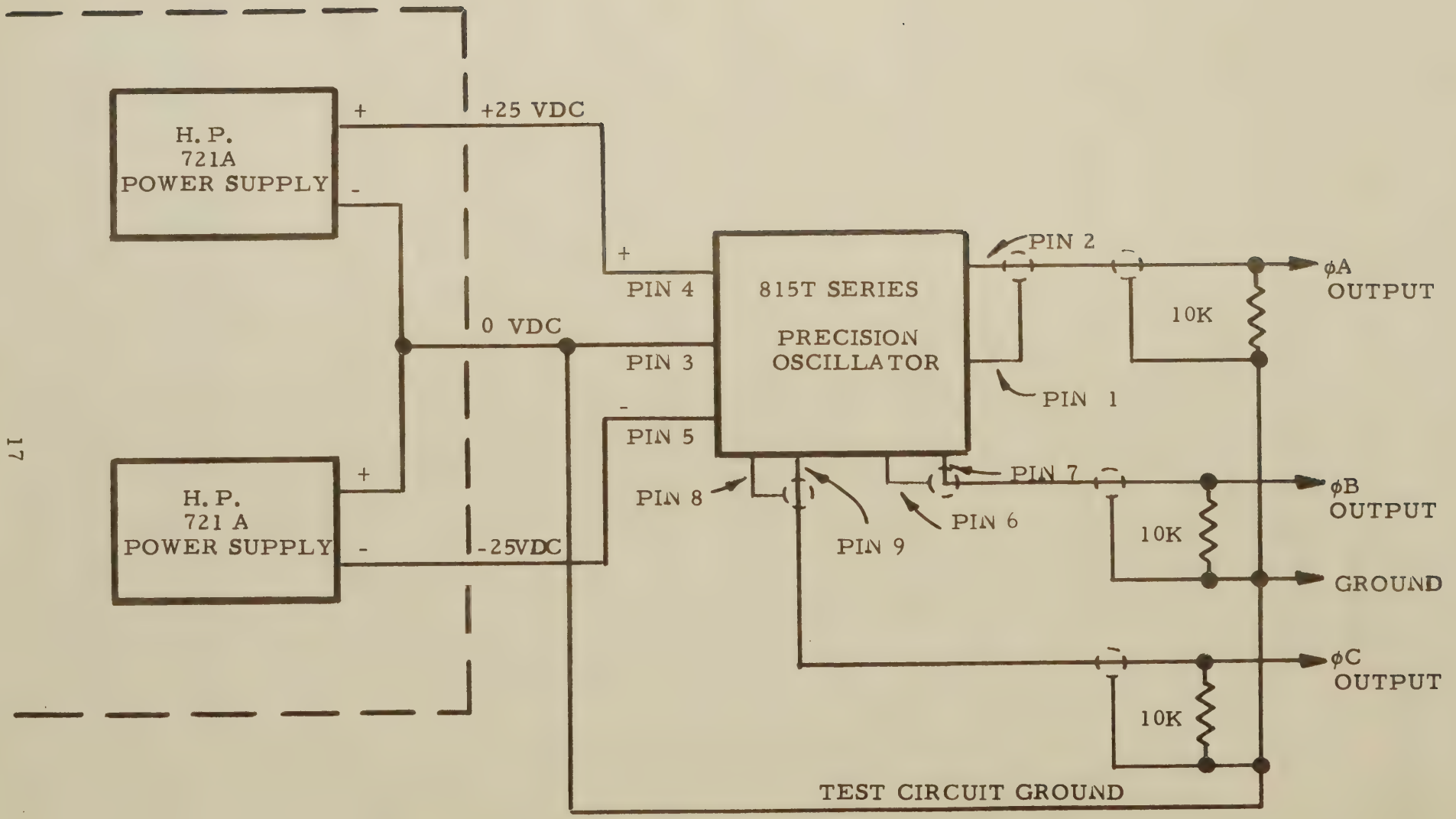


FIGURE 5-1. Test Circuit for 815T Series Oscillators

5.4.2 If the oscillator is a multiphase oscillator, then repeat 5.4.1 for the other phase or phases. The distortion should not exceed that specified in Section 5.4.1

5.5 OUTPUT FREQUENCY AND FREQUENCY STABILITY

Connect the unit as shown in Figure 5-1 and allow the unit to warm up for one hour in a 25°C environment. The output voltage should be approximately 5 volts rms. Adjust the AMPLITUDE control on the multi-phase oscillator, as required.

5.5.1 Measure the phase "A" output frequency at 25°C with the counter. The frequency of the oscillator should be within ±0.1 per cent of that indicated in the manual addendum. Record the frequency for reference in Section 5.5.2 below.

5.5.2 Increase the ambient temperature to 50°C and allow the unit to stabilize for one hour. The output frequency should change less than ±0.5 per cent from that indicated at 25°C

5.6 PHASE ACCURACY

This section of the manual is only applicable to multiphase versions of the 815T Series Oscillator. Connect the oscillator as shown in Figure 5-1 and allow the unit to warm up for one hour in a 25°C environment.

5.6.1 Rotate the front panel AMPLITUDE control fully clockwise so that the output of phase "A" (Pin 1 and Pin 2 of the printed circuit connector) is greater than 5 volts rms.

5.6.2 Connect a differential phase meter between the phase "A" output and the phase "C" output so that the phase meter reads the phase "C" output referenced to the phase "A" output. The phase meter should indicate +60 ± 2 degrees for the three phase open delta oscillator; +90 ±2 degrees for the two phase oscillator; and +120 ±2 degrees for the standard three phase oscillator.

5.6.3 For the standard three phase oscillator, measure the phase shift of the phase "B" output referenced to the phase "A" output. This phase shift must be -120 ±2 degrees. If problems are encountered, refer to Section 4.4 through 4.6 of this instruction manual.

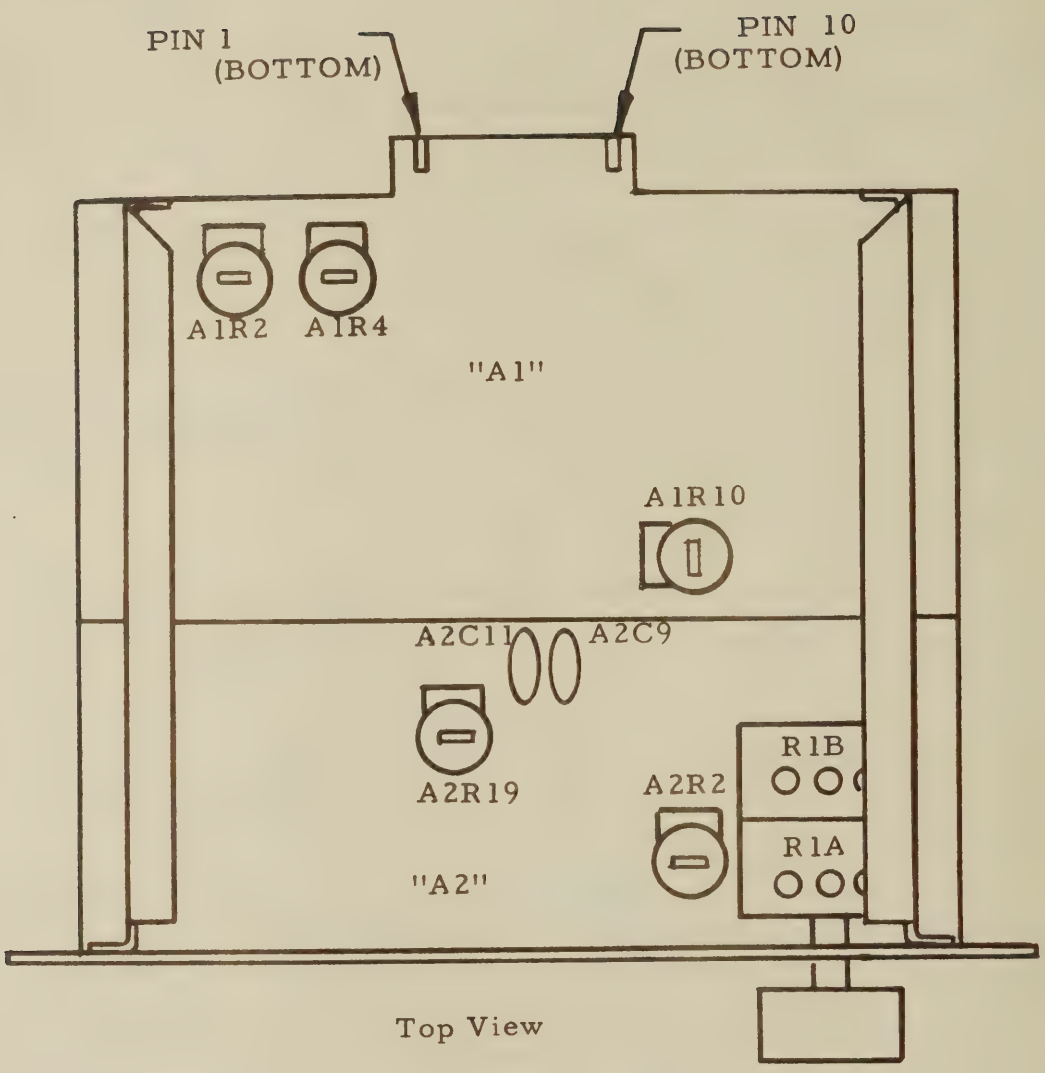


FIGURE 5-2. Locations of Internal Adjustment Potentiometers on Multiphase version of 815T Series Oscillator

MAINTENANCE AND TROUBLESHOOTING

6.1 GENERAL

The Behlman 815T Series Precision Oscillators are completely solid state and should provide years of trouble-free service. Since the instrument contains no moving parts, periodic maintenance is limited to cleaning in accordance with good commercial shop practices, and a periodic check of frequency accuracy and distortion at six month intervals. If the oscillator is operated in heavy duty applications where severe temperature extremes or mechanical shock are encountered, it is recommended that a more frequent calibration schedule be established.

6.2 TROUBLESHOOTING

6.2.1 Before attempting to repair the oscillator, check that the controls are properly set, that the DC input power is correct and that an excessive load is not connected to the output of the oscillator. Any load impedance less than 5 K ohm per phase should be considered escessive.

6.2.2 Check that the ±15 volt regulator circuits are operating properly and that they have less than 150 millivolts peak-to peak ripple.

6.2.3 Check that the basic Wien bridge oscillator is operating satisfactorily. Detailed information on this circuit is given in Section 3.1 and Section 4.3 in this manual.

6.2.4 Check that the servo feedback loop is operating satisfactorily. Detailed information on this circuitry is given in Section 3.1 of this manual. If the problem appears to be in this area, disconnect transistor A1Q2 and apply -1 to -2 volt DC bias to the gate of A1Q1. This opens the servo feedback loop and allows servicing of this circuitry by conventional signal tracing methods.

6.2.5 If the problem is in the single phase to multiphase converter, the circuit may be checked by conventional signal tracing methods.

CIRCUIT DIAGRAM

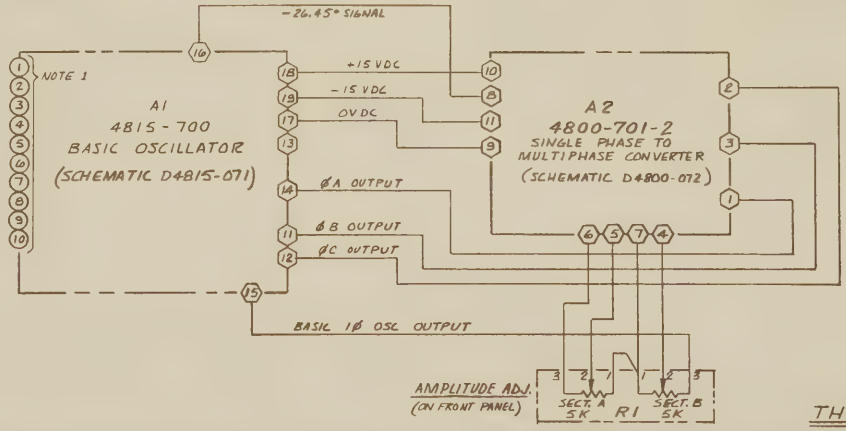
7.1 GENERAL

This section contains schematics and mechanical diagrams necessary for operation and maintenance of the 815T Series Precision Multiphase Oscillators. The schematic diagrams illustrate the circuit while the mechanical assemblies indicate the part placement.

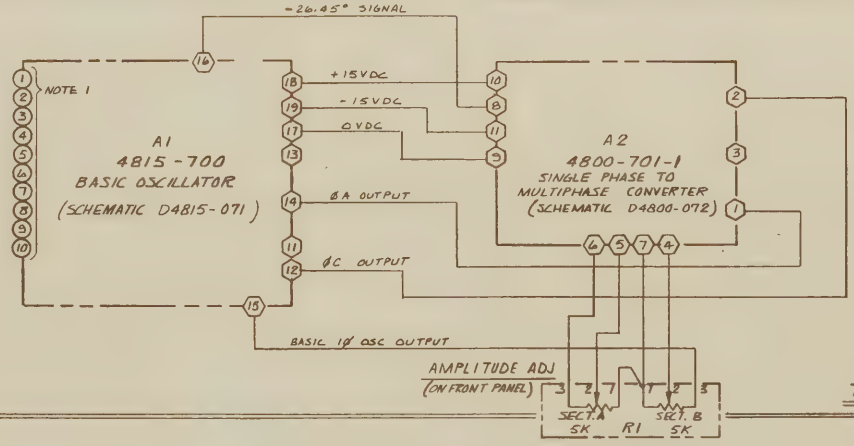
7.2 REFERENCE DESIGNATIONS

Partial reference disignators are shown on schematics and mechanical drawings. Prefix these reference designators with assembly and/or sub-assembly designation for the complete reference disignator. For example:

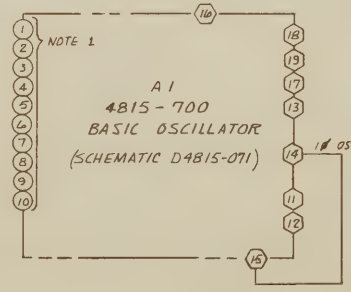
Assembly/Sub-Assembly	Component	Complete Designation
A1	C30	A1C30
None	T1	T1
A2	R1	A2R1



THREE PHASE



TWO PHASE



SINGLE PHASE

3. FOR TOP ASSY, SEE DWG D4815-400.
2. (X) INDICATES TIE POINT EYELET ON P.C. BOARD.
1. (X) INDICATES CONNECTOR CONTACT.

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
REQD PER ASSY							

DIM IN INCHES TOLERANCES XXX = .010, XX = .03, X° = 30'
BREAK ALL SHARP CORNERS & EDGES; MACH SURFACES ✓
DWG SIZE: D

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TITLE: INNER CONNECTING DIAGRAM 1Ø, 2Ø, & 3Ø

MODEL 815T

RELEASE				
CHECKER			PURCHASING	
DESIGN			PROJ ENGR	
DRFTSMN			CHF ENGR	

DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

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CONTRACT NO. | CODE IDENT 16067

DWG NO. D4815-070 | REV —

SCALE NONE | SHEET 1 OF 1

CALICO F-488

D4815-070 —

REVISIONS					
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

WIRING TABLE 1 (FOR 1φ UNITS)

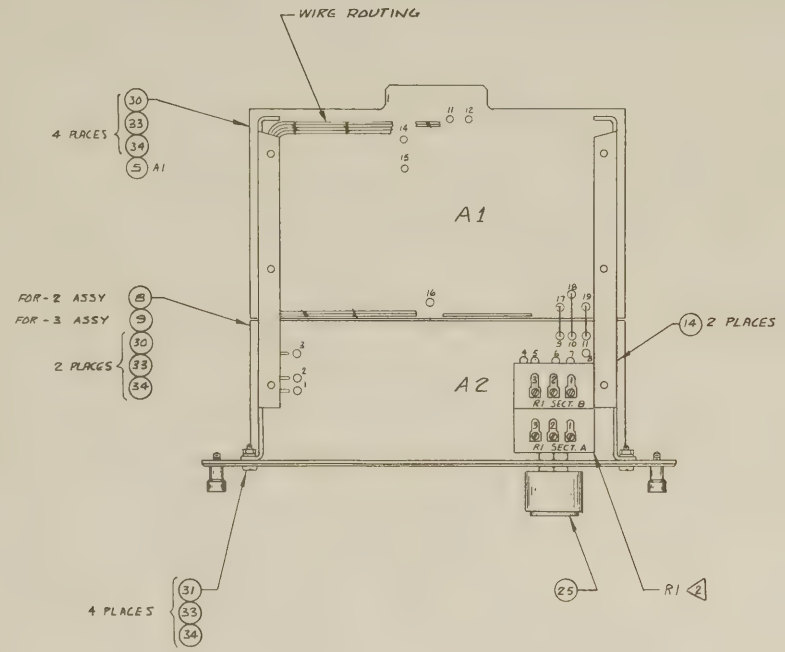
WIRE #	FROM	TO	WIRE	REMARKS
1	A1-14	A1-15	24 AWG	BUSS

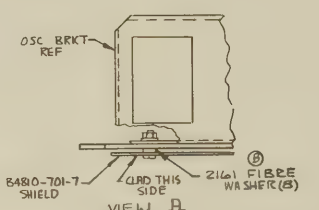
WIRING TABLE 2 (FOR 2φ UNITS)

WIRE #	FROM	TO	WIRE	REMARKS
1	A1-12	A2-2	24 AWG	BLK
2	A1-15	R1-B-3		BRN
3	A1-14	A2-1		RED
4	A1-16	A2-8		ORN
5	A1-17	A2-9		BUSS
6	A1-18	A2-10		BUSS
7	A1 19	A2-11		BUSS
8	A2-6	R1-A-3		YEL
9	A2-5	R1-A-2		GRN
10	A2-7	R1-B-1		BLU
11	A2-4	R1-B-2		VIO
12	R1-A-1	R1-B-1	24 AWG	BUSS

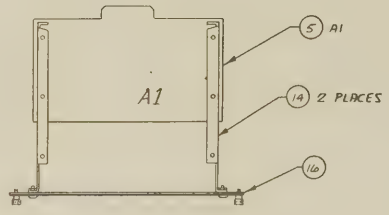
WIRING TABLE 3 (FOR 3φ UNITS)

WIRE #	FROM	TO	WIRE	REMARKS
1	A1-11	A2-3	24 AWG	GRAY

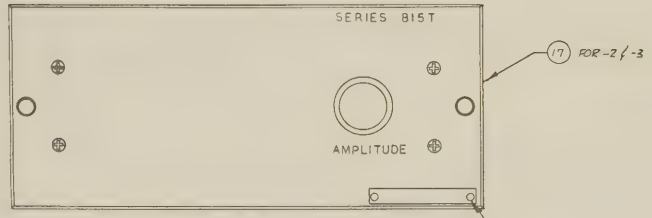




VIEW A
SIDE VIEW - FOR UNITS WITH 200Hz OR LESS FREQUENCY.



-1 ASSY - SINGLE PHASE
(USE WIRING TABLE 1)
SCALE 1:2 (FOR HARDWARE CALLOUTS SEE -2 & -3 ASSEMBLIES)



3. INSPECT GROUND CONTINUITY FROM FRONT PANEL CAPTIVE SCREW TO EACH SIDE RAIL, AND ON 200Hz OR LOWER FREQUENCY UNITS, CHECK TO GROUND SHIELD.
-2 ASSY - 2 PHASE (USE WIRING TABLE 2)
-3 ASSY - 3 PHASE (USE WIRING TABLE 2 & 3)

E INSTALL NUT ON POT. SIDE (BEHIND F/P) PRIOR TO INSTALLATION.

1 FOR INNER CONNECTION DIAGRAM, SEE DWG D4815-070.

NOTES: (UNLESS OTHERWISE SPECIFIED)

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
1		3	P/L 4815-400-3	PARTS LIST	SHEET 3			
	1	2	P/L 4815-400-2	PARTS LIST	SHEET 3			
	1	1	P/L 4815-400-1	PARTS LIST	SHEET: 3			
-3	-2	-1						

DIM IN INCHES TOLERANCES XXX ± .010, XX ± .03, X ± 30'. BREAK ALL SHARP CORNERS & EDGES. MACH SURFACES. DWG SIZE D.

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TITLE: SERIES 815T OSCILLATOR, 1φ, 2φ & 3φ ASSY

MODEL 815T

DASH NO	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

RELEASE Gil 2/14/64
CHECKER Walter J. 2/14/64 PURCHASING
DESIGN PROJ ENGR
DRFTSMN Wood 2/14/64 CHF ENGR

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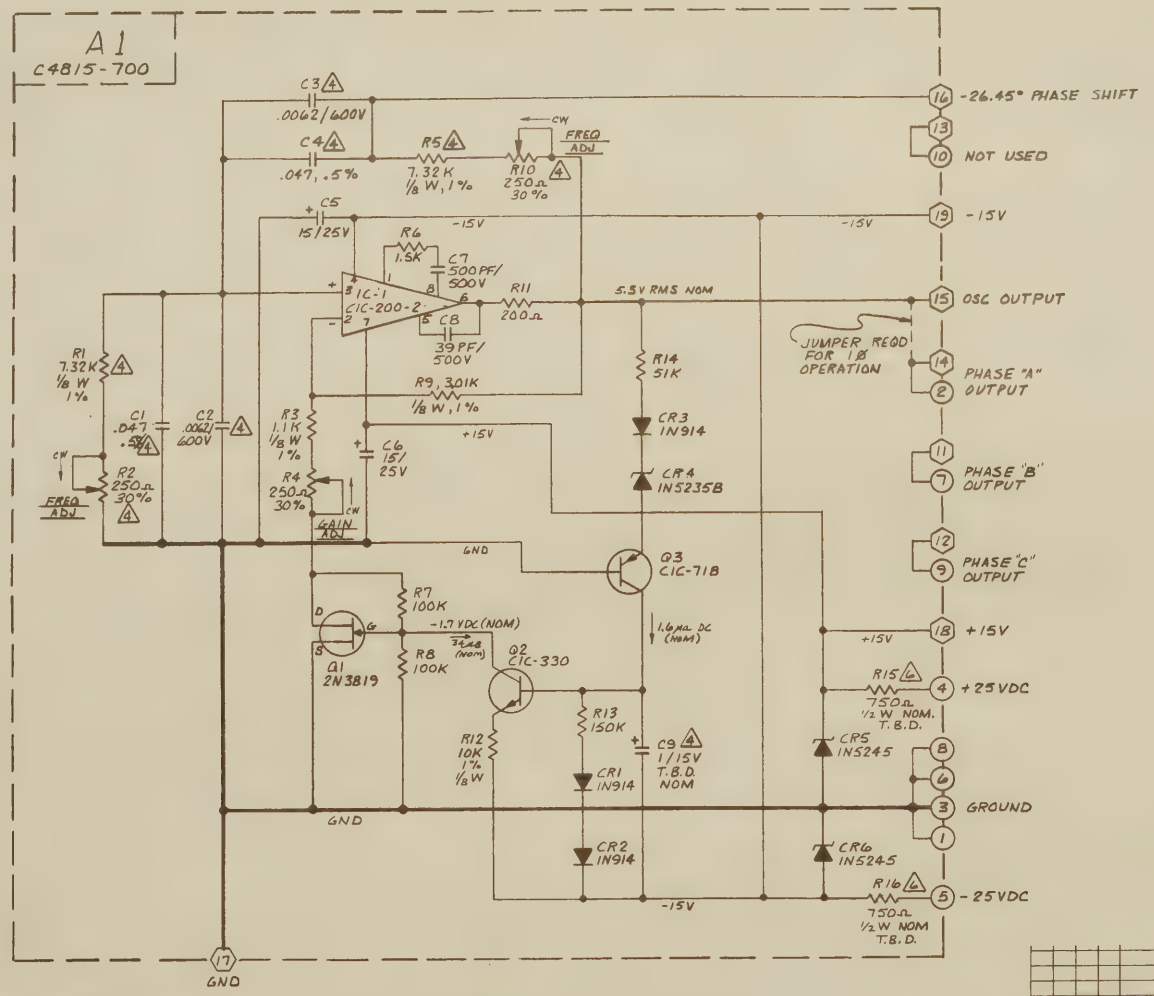
CONTRACT NO.
CODE IDENT 16067
DWG NO. D4815-400 REV B
SCALE FULL & NOTED SHEET 2 OF 3

D4815-400B



3. (X) INDICATES CONNECTOR CONTACTS.
   (X) INDICATES EYELET TIE POINT ON P.C. BOARD.
2. FOR P.C. BOARD ASSY, SEE DWG C4815-700.
   FOR 2Ø & 3Ø INTERCONNECTION, SEE DWG D4815-070.
   FOR FINAL ASSY, SEE DWG D4815-400.
1. RESISTORS ARE ¼W, 5%. VALUE IN OHMS.

NOTES: (UNLESS OTHERWISE SPECIFIED)

4 FOR 1Ø NOM. VALUE IS AS SHOWN. FOR 2Ø/3Ø NOM. VALUE IS 220Ω, 1W.

5. CAPACITANCE IN MICROFARADS.

4 COMPONENT VALUES ARE SHOWN FOR 400Hz OPERATION ONLY. FOR OPERATIONS AT OTHER FREQUENCIES SEE APPLICABLE PARTS LIST: " FREQUENCY DETERMINING PARTS LIST".

REVISIONS

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
REQD PER ASSY							

DIM IN INCHES TOLERANCES .XXX = .010, .XX = .03, X° = 30'. BREAK ALL SHARP CORNERS & EDGES MACH SURFACES. DWG SIZE D.

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TITLE: SCHEMATIC DIAGRAM, BASIC OSCILLATOR

MODEL 815T

RELEASE

CHECKER

DESIGN

DRFTSMN Linton M 5-15-70

PURCHASING

PROJ ENGR D. Bryan

CHF ENGR

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CONTRACT NO. | CODE IDENT 16067

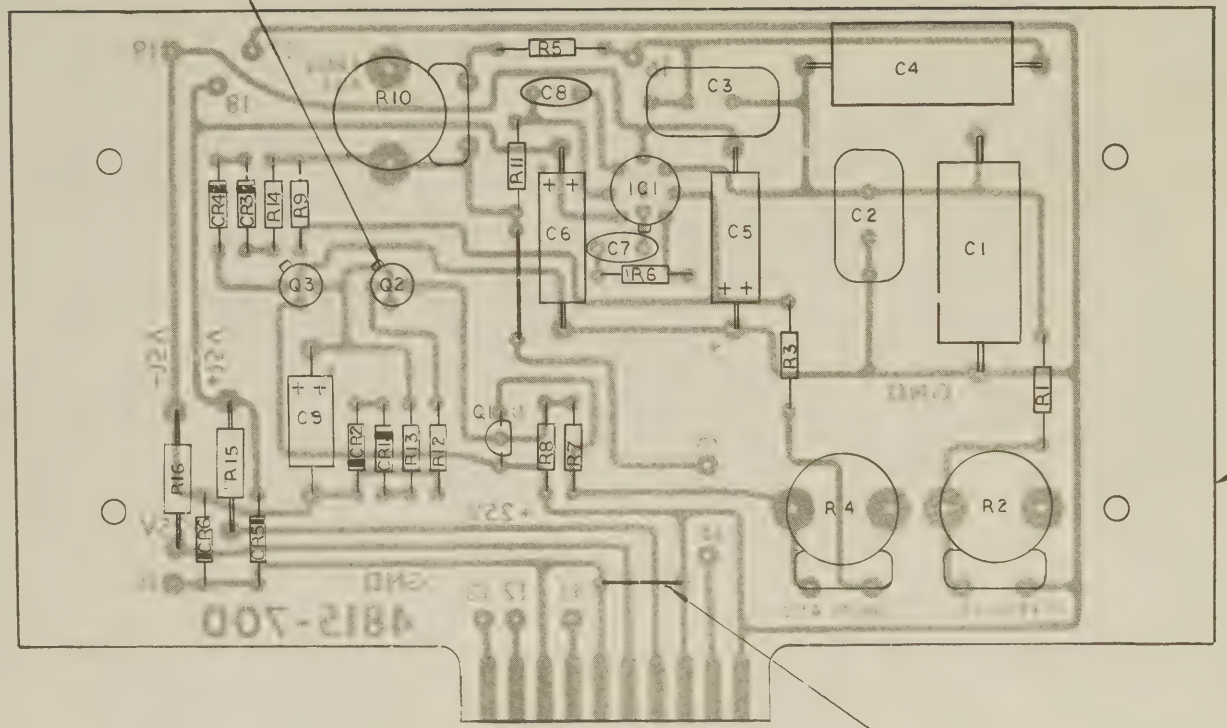
DWG NO. D4815-071 | REV Ø

SCALE NONE | SHEET 1 OF 1

DASH NO. | QTY. REQD | NEXT ASSEMBLY | EFF ON | AUTH

D4815-071 -

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD
		SEE SHEET 1.				



-1 P.C. BOARD ASSY
VIEW COMPONENT SIDE

C4815-700 A

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
		P/L 4815-400	PARTS LIST	SEE SHEETS 4 THRU —				

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH
-1	1	4815-400		

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓
DWG SIZE C

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TITLE: P.C. BOARD ASSY, BASIC OSC A1

MODEL 815T

RELEASE			PURCHASING
CHECKER	Wiener	6/11/70	PROJ ENGR
DESIGN			CHF ENGR
DRFTSMN	MARTIN	5-20-70	

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CONTRACT NO. | CODE IDENT 16067

DWG NO. C4815-700 | REV A

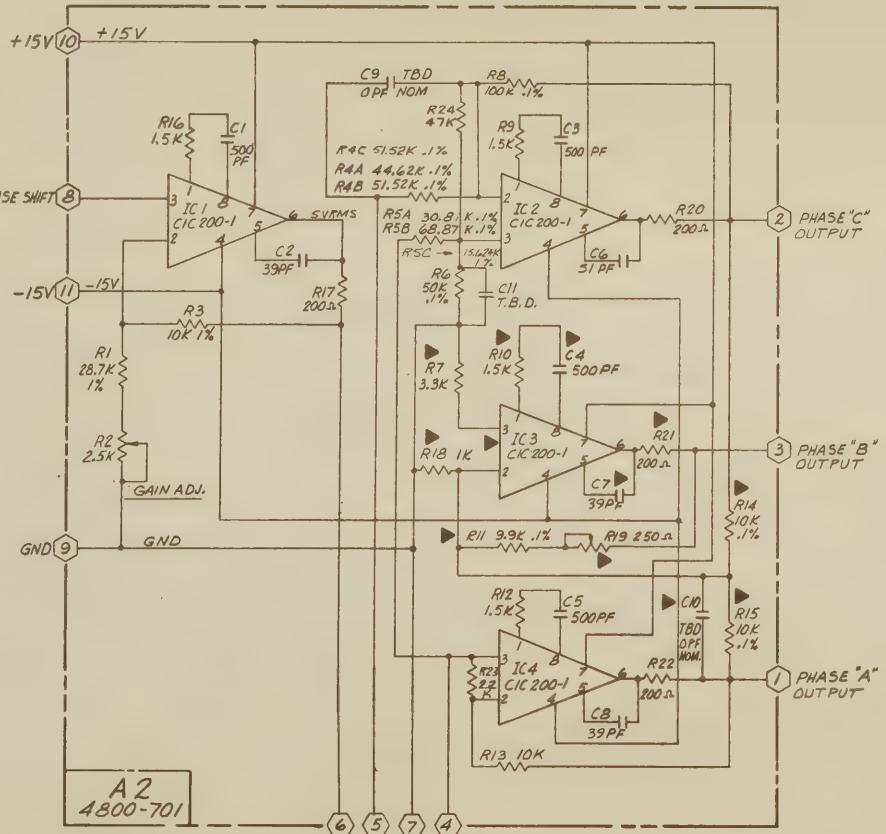
SCALE 2X | SHEET 2 OF —

CALICO F-102

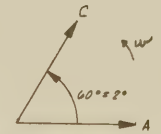
1. FOR SCHEMATIC DIAGRAM, SEE DWG D4815-071.

NOTES: (UNLESS OTHERWISE SPECIFIED)

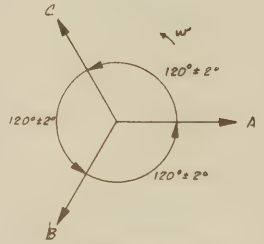
REVISIONS					
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE / APRD
A	D.C.	(R2 WAS 1K).			3/17/70
B	E.O.	INC. E.O. 362 & 368			9/14/70
C	E.O.	INC. E.O. 401			9/5/71
D	E.O.	INC. E.O. 422			



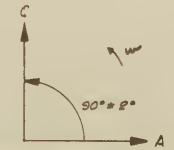
AMPLITUDE ADJ. ON FRONT PANEL (SHOWN FOR REF. ONLY)



VECTOR DIAGRAM FOR THREE PHASE OPEN DELTA VERSION OF OSCILLATOR



VECTOR DIAGRAM FOR THREE PHASE VERSION OF OSCILLATOR



VECTOR DIAGRAM FOR TWO PHASE VERSION OF OSCILLATOR

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. RESISTORS ARE ¼W 5%.
2. FOR P.C. BOARD ASSY SEE DWG #4800-701
3. ▶ NOT USED FOR TWO PHASE OSCILLATOR OR FOR 3φ OPEN DELTA OSCILLATOR.
4. ALL REF. DES. ENDING IN "A" ARE FOR 2φ OPERATION.
5. ALL REF. DES. ENDING IN "B" ARE FOR 3φ OPERATION.
6. ALL REF. DES. ENDING IN "C" ARE FOR 3φ OPEN DELTA OPERATION.
7. (X) INDICATES TIE POINT (EYELET) ON P.C. BOARD
8. FOR INNER CONNECTING DIAGRAM SEE DWG. # D4800-070 (FOR 20/20KHz) AND # D4800-074 (FOR 45/75Hz & 300/500Hz).

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

REQD PER ASSY

DIM IN INCHES TOLERANCES XXX = .010, XX = .03, X° = 30' — BREAK ALL SHARP CORNERS & EDGES MACH SURFACES — DWG SIZE D

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TITLE: SCHEMATIC DIAGRAM, SINGLE PHASE TO MULTIPHASE CONVERTER

MODEL: 800T TWO & THREE PHASE

RELEASE	E. Juste	2-4-9
CHECKER	Warren	2-4-9
DESIGN		
DRFTSMAN	Warren	
PURCHASING		
PROJ ENGR		
CHF ENGR		

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CONTRACT NO. — CODE IDENT 16067

DWG NO. D4800-072 — REV B

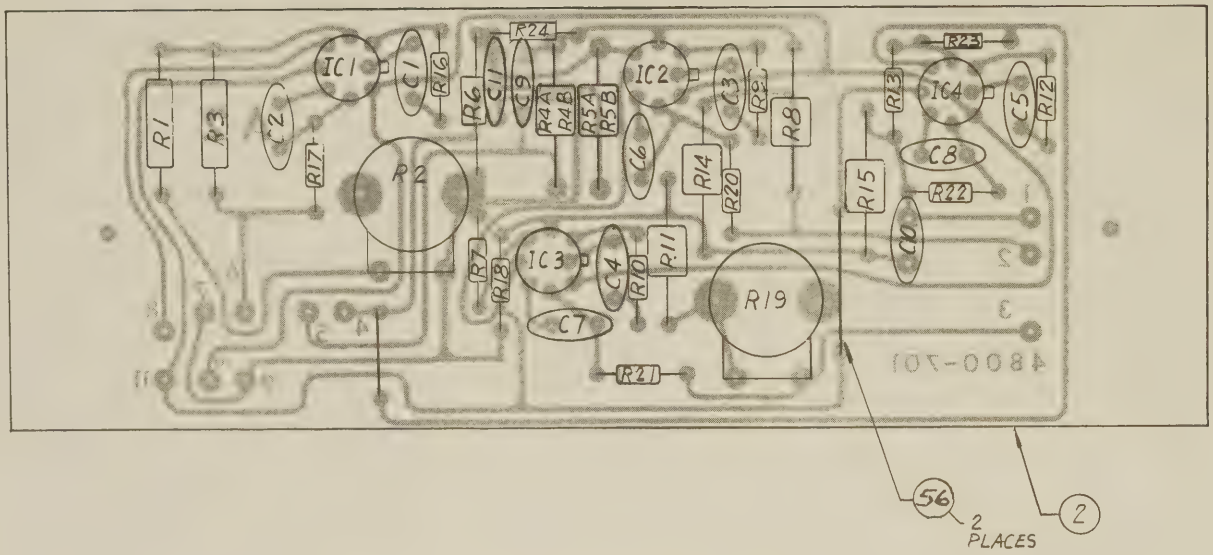
SCALE — — SHEET 1 OF 1

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

D4800-072 D

A2

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



-1 P.C. BOARD ASSY
VIEW COMPONENT SIDE
A2

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
-/		PL4800-701	PARTS LIST	SHEET 4 & 5				

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

DIM IN INCHES
TOLERANCES
.XXX = .010
.XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO, AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

TITLE SINGLE PHASE TO MULTIPHASE CONVERTER P.C. BOARD ASSY

MODEL 800T

RELEASE		
CHECKER		9/24/69 PURCHASING
DESIGN		PROJ ENGR
DRFTSMN		9/24/69 CHF ENGR

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.
CODE IDENT 16067
DWG NO. C4800-701
REV E
SCALE 2:1
SHEET 2 OF 5

CALICO F-102

1. FOR SCHEMATIC DIAGRAM SEE DWG. No. D4800-072

NOTES: (UNLESS OTHERWISE SPECIFIED)

C4800-701 E

A2

REPLACEMENT PARTS

8.1 GENERAL

This section contains ordering information and complete list of replaceable parts. Parts are listed by major assembly in alphanumerical order of their reference designators. Description, manufacturer's part number, manufacturer's code ident numbers (see Appendix A for list of manufacturers), and CALICO's stock numbers are indicated.

8.2 ORDERING INFORMATION

In order to provide our customers with prompt service on replacement parts, please provide the following information, when applicable, for each part ordered:

a) Model number and serial number of the instrument

b) CALICO part number of the sub-assembly where component is located

c) Component reference designator

d) Component description

e) Component manufacturer number and code ident

f) CALICO stock number

All replacement parts orders should be placed with CALIFORNIA INSTRUMENTS COMPANY, San Diego, California, 92111.

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | **PARTS LIST**

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	D4815-400-1	815T OSC, SINGLE PHASE	16067		1
	D4815-400-2	815T OSC, 2 PHASE	16067		2
	D4815-400-3	815T OSC, 3 PHASE	16067		3
					4
A1	C4815-700-1	P.C. BOARD ASSY, BASIC	16067		5
	APPLICABLE FREQUENCY DETERMINING PARTS LIST				6
					7
A2	4800-701-1	P.C. BOARD ASSY, 2ϕ	16067		8
A2	4800-701-2	P.C. BOARD ASSY, 3ϕ	16067		9
					10
R1	CLR 3033/11	POT, DUAL GANG, 5K-5K	0000F	5-70109	11
					12
					13
	4810-201-7	FRAME, PLUG-IN	16067	1-60000	14
					15
	4810-200-5	FRONT PANEL, 1ϕ	16067	1-10189	16
	4810-200-6	FRONT PANEL, 2ϕ or 3ϕ	16067	1-10190	17
					18
	4810-202-7	NAME PLATE	16067	1-60000	19
	SILKSCREEN - FREQUENCY, ACCURACY AND PHASE -				20
	USING FILM POSITIVE CALLED OUT ON ERA				21
					22
					23
					24
	PS-95-2-Blk	KNOB	21604	2-40295	25
					26
					27
	#00 x 1/8 Lg.	DRIVE SCREW, TYPE U	45722	2-10024	28
					29
	4-40UNC x 1/4 Lg.	SCREW, PAN HEAD			30
	4-40UNC x 3/8 Lg.	SCREW, PAN HEAD			31
					32
	#4	INT STAR LKWASH			33
	4-40UNC x 1/4 Hex	MACHINE NUT			34
					35
					36

MODEL 815T	CALICO P/N 4815-400		ASSY R.O.
TITLE 815T SERIES ASSEMBLY		SHT 3 OF 3	

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1	4815-700	P. C. BOARD ASSEMBLY	16067		1
					2
	4815-700-7	P. C. BOARD	16067	1-60109	3
	SEE SHEET 3	EYELET			4
					5
A1C1	*				6
A1C2	*				7
A1C3	*				8
A1C4	*				9
A1C5	TE 1205	CAPACITOR 15µf/25V	56289	6-10731	10
A1C6	TE 1205	CAPACITOR 15µf/25V	56289	6-10731	11
A1C7	DD 501	CAPACITOR 500pf/1000V	71590	6-10725	12
A1C8	CM05E390J03	CAPACITOR 39pf/500V	81349	6-10013	13
A1C9	*				14
					15
					16
					17
					18
					19
A1CR1	1N914	DIODE	81349	3-10118	20
A1CR2	1N914	DIODE	81349	3-10118	21
A1CR3	1N914	DIODE	81349	3-10118	22
A1CR4	1N5235B	DIODE, ZENER	04713	3-10196	23
A1CR5	1N5245	DIODE, ZENER	04713	3-10067	24
A1CR6	1N5245	DIODE, ZENER	04713	3-10067	25
					26
					27
					28
					29
A1IC1	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	30
					31
					32
					33
					34
					35
	* SEE FREQUENCY	DETERMINING PARTS LIST			36

MODEL	815T	CALICO P/N 4815-700	ASSY R.O.
TITLE	P. C. BOARD, BASIC OSCILLATOR	SHT 4 OF 7	A1

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1Q1	2N3819	FIELD EFFECT TRANSISTOR	01295	3-30197	37
A1Q2	CIC-330	TRANSISTOR	16067	3-30008	38
A1Q3	CIC-718	TRANSISTOR	16067	3-30041	39
					40
					41
					42
A1R1	*				43
A1R2	*				44
A1R3	RN60C1101F	RESISTOR 1.1K 1/8W 1%	81349	5-60423	45
A1R4	U-201R251B	POTENTIOMETER 250Ω	71450	5-70012	46
A1R5	*				47
A1R6	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	48
A1R7	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	49
A1R8	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	50
A1R9	RN60C3011F	RESISTOR 3.01K 1/8W 1%	81349	5-60233	51
A1R10	*				52
A1R11	RC07GF201J	RESISTOR 200Ω 1/4W 5%	81349	5-10036	53
A1R12	RN60D1002F	RESISTOR 10K 1/8W 1%	81349	5-60079	54
A1R13	RC07GF154J	RESISTOR 150K 1/4W 5%	81349	5-10104	55
A1R14	RC07GF513J	RESISTOR 51K 1/4W 5%	81349	5-10093	56
A1R15	RC20GF751J ◁1	RESISTOR 750Ω 1/2W 5%	81349	5-20031	57
A1R16	RC20GF751J ◁1	RESISTOR 750Ω 1/2W 5%	81349	5-20031	58
					59
					60
	RCT018110-1A	TRANSIPAD, TO-18	19080	2-40297	61
					62
	20 AWG	BUSS WIRE			63
					64
					65
					66
					67
					68
	◁1 FOR 2Ø and 3Ø	UNITS VALUE IS 220Ω, 1W RC32GF221J, 5-30025			69
					70
	* SEE FREQUENCY DETERMINING PARTS LIST				71
					72

MODEL	CALICO P/N	ASSY R.O.
815T	4815-700	

TITLE	SHT	OF
P. C. BOARD, BASIC OSCILLATOR	5	A1

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A2	4800-701-0	P. C. BOARD ASSY--Basic	16067		1
	4800-701-1	P. C. BOARD ASSY--Two ϕ	16067		2
	4800-701-2	P. C. BOARD ASSY--Three ϕ	16067		3
	-7	P. C. BOARD	16067	1-55067	4
	SEE SHEET 3	EYELET			5
					6
					7
A2C1	DD 501	CAPACITOR 500 pf	71590	6-10725	8
A2C2	CM05E390J03	CAPACITOR 39 pf	04062	6-10013	9
A2C3	DD501	CAPACITOR 500 pf	71590	6-10725	10
A2C4	DD501	CAPACITOR 500 pf	71590	6-10725	11
A2C5	DD501	CAPACITOR 500 pf	71590	6-10725	12
A2C6	CM05E510J03	CAPACITOR 51 pf	04062	6-10016	13
A2C7	CM05E390J03	CAPACITOR 39 pf	04062	6-10013	14
A2C8	CM05E390J03	CAPACITOR 39 pf	04062	6-10013	15
A2C9	t.b.d.	CAPACITOR			16
A2C10	t.b.d.	CAPACITOR			17
A2C11	CM05	CAPACITOR, T.B.D.	81349		18
					19
					20
A2IC1	CIC 200-1	INTEGRATED CIRCUIT	16067	3-30134	21
A2IC2	CIC 200-1	INTEGRATED CIRCUIT	16067	3-30134	22
A2IC3	CIC 200-1	INTEGRATED CIRCUIT	16067	3-30134	23
A2IC4	CIC 200-1	INTEGRATED CIRCUIT	16067	3-30134	24
					25
					26
					27
A2R1	RN60D2872F	RESISTOR 28.7K 1%	JEDEC	5-60107	28
A2R2	U-201R252	VAR. RESISTOR 2.5K	11237	5-70023	29
A2R3	RN60D1002F	RESISTOR 10K 1%	JEDEC	5-60079	30
A2R4A	S51-9-44.62K-.1%	RESISTOR 44.62K .1%	17745	5-80134	31
A2R4B	S51-9-51.52K-.1%	RESISTOR 51.52K .1%	17745	5-80136	32
A2R5A	S51-9-30.8K-.1%	RESISTOR 30.8K .1%	17745	5-80133	33
A2R5B	S51-9-68.87K-.1%	RESISTOR 68.87K .1%	17745	5-80137	34
A2R6	S51-9-50.0K-.1%	RESISTOR 50K .1%	17745	5-80135	35
A2R7	RC07GF332J	RESISTOR 3.3K 1/4W 5%	JEDEC	5-10064	36

MODEL 800T — CALICO P/N 4800-701 — ASSY R.O. A2

TITLE SINGLE ϕ TO MULTI ϕ CONVERTER BOARD ASSEMBLY — SHT 4 OF 5

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A2R8	S51-9-100.0K-.1%	RESISTOR 100K .1%	17745	5-80138	37
A2R9	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	38
A2R10	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	39
A2R11	S51-9-9.9K-.1%	RESISTOR 9.9K .1%	17745	5-80131	40
A2R12	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	41
A2R13	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	42
A2R14	S51-9-10.0K-.1%	RESISTOR 10K .1%	17745	5-80132	43
A2R15	S51-9-10.0K-.1%	RESISTOR 10K .1%	17745	5-80132	44
A2R16	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	45
A2R17	RC07GF201J	RESISTOR 200Ω 1/4W 5%	JEDEC	5-10036	46
A2R18	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	47
A2R19	U-201R251B	VAR. RESISTOR 250Ω	11237	5-70012	48
A2R20	RC07GF201J	RESISTOR 200Ω 1/4W 5%	JEDEC	5-10036	49
A2R21	RC07GF201J	RESISTOR 200Ω 1/4W 5%	JEDEC	5-10036	50
A2R22	RC07GF201J	RESISTOR 200Ω 1/4W 5%	JEDEC	5-10036	51
A2R23	RC07GF222J	RESISTOR 2.2K 1/4W 5%	JEDEC	5-10060	52
A2R24	RC07GF473J	RESISTOR 47K 1/4W 5%	JEDEC	5-10092	53
					54
					55
	#24 AWG	BUSS WIRE			56
					57

MODEL 800T — CALICO P/N 4800-701 — ASSY R.O. A2

TITLE SINGLE ϕ TO MULTI ϕ CONVERTER BOARD ASSEMBLY — SHT 5 OF 5

FREQUENCY DETERMINING PARTS LIST

The following addendum parts list defines value and manufacturer's part number of components not listed in the preceeding parts list.

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	REF. DRAWING	4815-700-1 and 4815-071 -	400 Hz		1
					2
A1C1	PD1A 473 ± .5%	CAPACITOR .047 µf .5%	12406	6-10552	3
A1C2	6MPD-1-622J	CAPACITOR .0062/ 600V 5%	04062	6-10545	4
A1C3	6MPD-1-622J	CAPACITOR .0062 /600V 5%	04062	6-10545	5
A1C4	PD1A 473 ± .5%	CAPACITOR .047 µf .5%	12406	6-10552	6
A1C9	TE 1148	CAPACITOR 1 µf / 15V	56289	6-10151	7
					8
					9
					10
A1R1	RN60C7321F	RESISTOR 7.32K 1/8W 1%	81349	5-60243	11
A1R2	U-201R251B	POTENTIOMETER 250Ω	71450	5-70012	12
A1R5	RN60C7321F	RESISTOR 7.32K 1/8W 1%	81349	5-60243	13
A1R10	U-201R251B	POTENTIOMETER 250Ω	71450	5-70012	14
					15
					16
					17
					18
					19
					20
					21
					22
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MODEL 815T | CALICO P/N 4815-700 | ASSY R.O 10 20 30 400H

TITLE FREQUENCY DETERMINING PARTS LIST | SHT 7 OF

APPENDIX A

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbook H4-1 and its latest supplement. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbook.

0000A	ElectriCord	Westfield, Pa.
0000B	Tech. Prod. Sales	Sorrento Valley, Ca.
0000C	Jackson Bros.	Waddon, Surrey, England
0000D	Chicago Std. Transformer Co.	Chicago, Ill.
0000E	Use Code #08289	
0000F	Colvern	Santa Monica, Ca.
0000G	Use Code #30983	
0000H	Mial Of Italy c/o Q. C. Components	Los Angeles, Ca.
00141	Pic Design Corp.	E. Rockaway, N. Y.
00544	Metal-Cal Div, Avery Prod. Corp.	Inglewood, Ca.
00656	Aerovox Corporation	New Bedford, Mass.
00779	AMP, Inc.	Harrisburg, Pa.
00853	Sangamo Electric Company	Pickens, S. C.
00866	Goe Eng. Co., Inc.	City of Industry, Ca.
01121	Allen-Bradley Company	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Ca.
01281	TRW Semiconductors, Inc.	Lawndale, Ca.
01295	Texas Instruments, Inc.	Dallas, Tex.
02335	Fairchild Controls Corp.	Hicksville, LI, N. Y.
02660	Amphenol Corporation	Broadview, Ill.
02799	ARCO Capacitors, Inc.	Los Angeles, Ca.
03507	General Electric Company	Syracuse, N. Y.
03508	General Electric Company	Syracuse, N. Y.
03516	General Electric Company	Somersworth, N. H.
03797	Eldema Corporation	Compton, Ca.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N. J.
03911	Clairex Corporation	New York, N. Y.
04009	Arrow-Hart and Hegeman Elec. Co.	Hartford, Ct.
04062	Use Code #02799	
04713	Motorola Semiconductor Prod., Inc.	Phoenix, Ariz.
04963	3-M	St. Paul, Minn.
05276	Pomona Electronics Co., Inc.	Pomona, Ca.
05397	Kemet, Union Carbide Corp.	Cleveland, Ohio
05820	Wakefield Engineering, Inc.	Wakefield, Mass.
06184	Conelco Components	San Bernadino, Ca.
06223	Kooltronic Fan Company	Princeton, N. J.
06229	Electrovert, Incorporated	Mt. Vernon, N. Y.
06514	Stantron, Wyco Metal Products	N. Hollywood, Ca.
06540	Amathom Elect. Hardward	New Rochelle, N. Y.
07088	Kelvin Electric Company	Van Nuys, Ca.
07256	Silicon Transistor Corp.	Garden City, N. Y.
07263	Fairchild Camera and Instr. Corp.	Mt. View, Ca.
07387	Birtcher Corporation	Los Angeles, Ca.
07556	Unitrack, Calabro Plastics	Upper Darby, Pa.
07716	IRC, Incorporated	Burrington, Iowa
08065	Accurate Rubber and Plastics Co.	San Diego, Ca.
08289	Blinn-Delbert Co., Inc.	Pomona, Ca.
08718	Use Code #71468	
08730	Vemaline Products Co.	Franklin Lakes, N. J.
09026	Babcock Electronics Corp.	Costa Mesa, Ca.
09145	Atohm, Technical Industries, Inc.	Burbank, Ca.
09353	C and K Components, Inc.	Newton, Mass.
11432	Diamond Metal Sales	Gardena, Ca.
11815	Cherry Rivet Div., Townsend Co.	Santa Ana, Ca.
12020	Ovenaire, Incorporated	Charlottesville, Va.
12143	Bendix Corporation	Santa Ana, Ca.
12405	Hysol Corporation	El Monte, Ca.
12406	Elpac, Incorporated	Fullerton, Ca.
12463	Omtronics Mfg., Incorporated	Omaha, Neb.
12697	Clarostat Mfg. Co., Incorporated	Dover, N. H.
13103	Thermalloy Company	Dallas, Tex.
13454	Texas Crystals	River Grove, Ill.
14099	Semtech Corporation	Newbury Park, Ca.
14655	Cornell-Dubilier Elect. Corp.	Newark, N. J.
14752	Electro Cube, Incorporated	San Gabriel, Ca.
15112	Electra Scientific Corporation	Fullerton, Ca.
15801	Fenwall Electronics	Framingham, Mass.
15818	Amelco, Teledyne, Incorporated	Mt. View, Ca.
15909	Use Code #17870	
15912	Digital Sensors, Incorporated	Los Angeles, Ca.
16067	California Instruments Company	San Diego, Ca.
16758	Delco Radio Div., General Motors	Kokomo, Ind.
16902	Simpson Instruments, Inc.	Escondido, Ca.
17745	Angstrohm Precision, Inc.	Van Nuys, Ca.
17838	Mektron, California General, Inc.	Chula Vista, Ca.
17870	Daven Div., Thomas A. Edison	Manchester, N. H.
18121	Wilshire Foam Products, Inc.	Gardena, Ca.
18702	Ducommun Metals and Supply Co.	Los Angeles, Ca.
18722	RCA	Mountaintop, Pa.
19080	The Robinson Company	Hawthorne, Ca.
19781	Potter Company	Sun Valley, Ca.
20857	South Bay Cable Corp.	Gardena, Ca.
21604	Buckeye Stamping Company	Columbus, Ohio
22599	Elastic Stop Nut Corporation	Van Nuys, Ca.
23039	Deccofelt Products Company	Glendora, Ca.
23050	Product Components Corp.	Hastings-on-Hudson, N. Y.
23783	British Radio Electric Ltd.	Washington, D. C.
23936	Pamotor, Incorporated	San Francisco, Ca.
24931	Specialty Connector Co., Inc.	Indianapolis, Ind.
25684	Victoreen Instrument Co., Inc.	Oak Lawn, Ill.
25706	Daburn Electronics and Cable Corp.	New York, N. Y.
26528	Lamcor, Incorporated	Anaheim, Ca.
26533	Zero Manufacturing Company	Burbank, Ca.
27014	National Semi-Conductor Corp.	Santa Clara, Ca.
27191	Cutler-Hammer, Inc.	Milwaukee, Wisc.
27556	IMB Electronic Products	Santa Fe Springs, Ca.
80223	United Transformer Co. (Late Entry)	New York, N. Y.
27683	Varo, Incorporated	St. Garland, Tex.
28520	Heyman Mfg. Company (Heyco)	Kenilworth, N. J.
30086	I-T-E Circuit Breaker Co.	Philadelphia, Pa.
30817	Instrument Specialties Co.	Little Falls, N. J.
30983	Electra/Midland	San Diego, Ca.
42190	Muter Company	Chicago, Ill.
44655	Ohmite Manufacturing Company	Skokie, Ill.
45722	Parker-Kalon	Clifton, N. J.
46384	Penn. Eng. and Mfg. Corp.	Doylestown, Pa.
56289	Sprague Electric Company	North Adams, Mass.
58474	Superior Electric Company	Bristol, Ct.
59730	Thomas and Betts Company	Elizabeth, N. J.
60741	Triplett Electrical Instrument Co.	Bluffton, Ohio
63743	Ward Leonard Electric Co.	Mt. Vernon, N. Y.
70903	Belden Manufacturing Co.	Chicago, Ill.
71002	Birnbach Radio Company, Inc.	New York, N. Y.
71279	Cambridge Thermionic Corp.	Cambridge, Mass.
71400	Bussmann Mfg. Div., McGraw-Edison Co.	St. Louis, Mo.
71450	CTS Corporation	Elkhart, Ind.
71468	ITT Cannon Electric, Inc.	Los Angeles, Ca.
71590	Centralab Div., Globe-Union, Inc.	Milwaukee, Wis.
71785	Cinch Manufacturing Company	Chicago, Ill.
72259	Nytronics, Incorporated	Berkeley Heights, N. J.
72619	Dialight Corporation	Brooklyn, N. Y.
72982	Erie Technological Products, Inc.	Erie, Pa.
73138	Beckman Instruments, Inc.	Fullerton, Ca.
73559	Carling Electric, Inc.	West Hartford, Ct.
73734	Federal Screw Products, Inc.	Chicago, Ill.
73899	JFD Electronics Company	Brooklyn, N. Y.
73949	Guardian Electric Mfg. Co.	Chicago, Ill.
73957	Groov-Pin Corporation	Ridgefield, N. J.
74193	Heinemann Electric Company	Trenton, N. J.
74276	Signalite, Incorporated	Neptune, N. J.
74542	Hoyt Electrical Instrument Works	Penacook, N. H.
74545	Harvey Hubbell, Inc.	Bridgeport, Ct.
74970	E. F. Johnson Company	Waseca, Minn.
75382	Kulka Electric Corporation	Mt. Vernon, N. Y.
75915	Littelfuse, Incorporated	Des Plaines, Ill.
75987	Use Code #95987	
76055	Mallory Controls	Frankfort, Ind.
76348	Miller Products Company	New York, N. Y.
76493	J. W. Miller Company	Los Angeles, Ca.
76854	Oak Manufacturing Company	Crystal Lake, Ill.
77342	Potter and Brumfield Div., Amer. Machine and Foundry Company	E. Princeton, Ind.
78189	Shakeproof Div., Illom's Tool Works	Chicago, Ill.
78299	Struthers-Dunn, Incorporated	Pitman, N. J.
78488	Stackpole Carbon Company	St. Marys, Pa.
78526	Stanwyck Winding Company, Inc.	Newburgh, N. Y.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78947	Ucinite Company	Newtonville, Mass.
79130	Johns-Manville Products. Corp.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Phila., Pa.
79963	Zierick Mfg. Corporation	New Rochelle, N. Y.
80112	G. C. Electronics Company	Los Angeles, Ca.
80294	Bourns, Incorporated	Riverside, Ca.
80368	Sylvania Electric Products, Inc.	New York, N. Y.
81073	Grayhill, Incorporated	La Grange, Ill.
81095	Triad Transformer Corp.	Venice, Ca.
81312	Winchester Electronics	Oakville, Ct.
81349	Military Specs., Standardization Division, Directorate of Logistic Services DSA	
82389	Switchcraft, Incorporated	Chicago, Ill.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N. Y.
83058	Car Fastener Company	Cambridge, Mass.
83324	Rosan, Incorporated	Newport Beach, Ca.
83330	Herman H. Smith, Inc.	Brooklyn, N. Y.
83594	Burroughs Corporation	Plainfield, N. J.
83701	Electronic Devices, Incorporated	Yonkers, N. Y.
84171	Arco Electronics, Inc.	Great Neck, N. Y.
86684	RCA	Harrison, N. J.
87034	Marco-Oak Industries	Anaheim, Ca.
88026	Use Code #27191	
88245	Useco Div., Litton Industries	Van Nuys, Ca.
90201	Mallory Capacitor Company	Indianapolis, Ind.
91637	Dale Electronics, Inc.	Columbus, Neb.
91662	Elco Corporation	Willow Grove, Pa.
91812	Janco Corporation	Burbank, Ca.
91833	Keystone Electronics Corp.	New York, N. Y.
91929	Micro Switch Div., Honeywell, Inc.	Freeport, Ill.
92194	Alpha Wire Corporation	Elizabeth, N. J.
92219	Waldom Electronics, Inc.	Chicago, Ill.
93332	Sylvania Electric Products, Inc.	Woburn, Mass.
94222	Southco, Incorporated	Lester, Pa.
95146	Alco Electronics Products	Lawrence, Mass.
95303	RCA	Cincinnati, Ohio
95416	Use Code #95146	
95987	Weckesser Company, Inc.	Chicago, Ill.
96682	Genisco, Incorporated	Compton, Ca.
97954	U. S. Components, Incorporated	Bronx, N. Y.
98159	Rubber Teck, Incorporated	Gardena, Ca.
98278	Microdot, Incorporated (Lerco)	S. Pasadena, Ca.
98978	IERC	Burbank, Ca.
99392	STM Corporation	Oakland, Ca.
99515	Marshall Industries	Monrovia, Ca.
99517	Vacco Industries	El Monte, Ca.
99800	Delevan Electronics Corporation	Aurora, N. Y.

ONE YEAR WARRANTY

CALIFORNIA INSTRUMENTS COMPANY warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Excepted from this warranty are tubes, fuses, and batteries which carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS COMPANY will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned to the Company freight prepaid, and when examination reveals that the fault has not occurred because of misuse or abnormal conditions of operation. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALICO will submit an estimate for such charges before commencing repair if so requested.

PROCEDURE FOR SERVICE

If a fault develops, notify CALICO or its local representative, giving full details of the difficulty, and including the model number and serial number. On receipt of this information, service data or shipping instructions will be furnished. If shipment is indicated, forward the instrument, freight prepaid, to the authorized repair station indicated in the instruction If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.

DAMAGE IN TRANSIT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. CALICO will advise the disposition to be made of the equipment and arrange for repair or replacement. Please include model number and serial number when referring to the instrument.

8303 SERIES
DIGITAL
OHMMETER

CALICO
CALIFORNIA INSTRUMENTS CORPORATION

3511 MIDWAY DRIVE / SAN DIEGO, CALIFORNIA 92110

CALIFORNIA INSTRUMENTS CORPORATION
San Diego, California 92117

September 1969
Original
CALICO

INSTRUCTION MANUAL

8303 SERIES

DIGITAL

OHMMETER

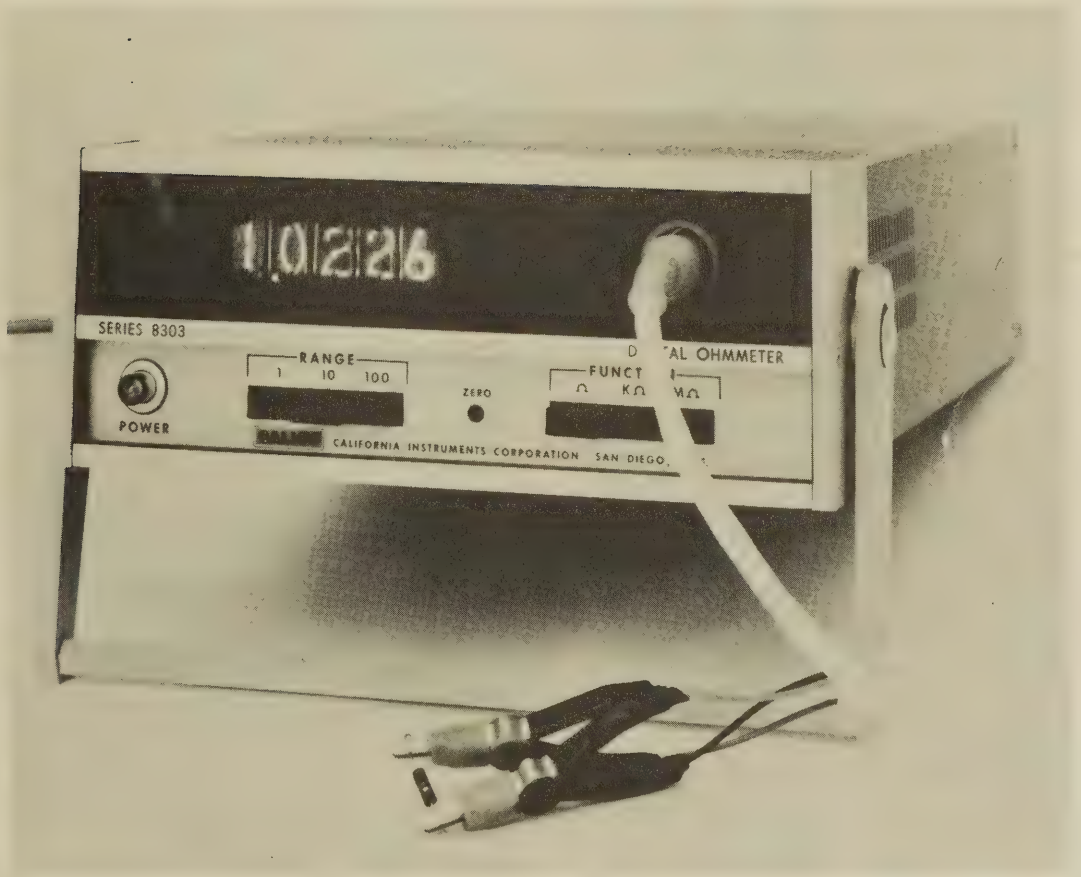

FIGURE 1.

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3	INTERNAL WAVEFORMS	9
4	TRUTH TABLE	13
5	ADJUSTMENTS and TEST POINTS	20

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	8300-404	Unit Assembly
A2	8300-700	Analog and Decade Board Assembly
	8300-071	Schematic (Three Sheets)
A8	8300-705	Filter Board Assembly
	8300-075	Schematic
A10	8300-703	Pre-Amplifier Board Assembly
	8300-073	Schematic
A11	8300-713	Power Supply #3 Board Assembly
	8300-083	Schematic
A12	8300-712	Power Supply #2 Board Assembly
	8300-081	Schematic
A13	8300-711	Power Supply #1 Board Assembly
	8300-082	Schematic
A16	8300-724	Power Supply Board Assembly
	8300-087	Schematic
A17	8300-723	Constant Current Board Assembly
	8300-086	Schematic
A18	8300-722	Master Board Assembly
	8300-085	Schematic
A19	8300-725	Overrange Board Assembly
	8300-088	Schematic
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A15	8300-710	Print Board Assembly
	8300-080	Schematic

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2.2	POWER REQUIREMENTS	4
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PARTS LIST

APPENDIX A

CODE LIST OF MANUFACTURERS

APPENDIX B

PRINT-OUT OPTION (If Supplied)

SPECIFICATIONS

Range (in ohms)	1,	10,	100,	1K,	10K,	100K,	1M,	10M,	100M
Accuracy at 25°C									
% of Reading	← ±0.02 →						±.03	±0.1	±1.0
and % of Full Scale	← ±0.01 →						±.02	±0.1	±1.0
Source Current	100ma	10ma	1ma	100μa	100μa	100μa	10μa	1μa	100na
Stability/Month	← .02% →						.05%	0.1%	1.0%
Temperature Coefficient/°C									
% of Reading	← .002 →						.005	.01	.09
and % of Full Scale	← .001 →						.002	.005	.02
Line Voltage Stability	← .001%/volt →							.002%/volt	.005%/volt
Nominal Settling Time to Accuracy	← 1 sec →							10 sec	100 sec

Common Specifications

Resolution:	.01% of Full Scale
Linear Overrange:	20% *
Ambient Temperature:	0 to 50°C
Power:	15 watts max. 115 ±10VAC or 230 ±20VAC, 50 to 400 Hz
Weight:	8 lbs. net, 12 lbs, shipping
Maximum Safe Input:	200VDC or peak AC
Display Time:	200 msec nominal
Digitizing Time:	150 msec
Size:	3 1/2" x 8 3/4" x 14 1/2"

* Overload indicator turns on for reading above 11999.

All specifications apply when tested in accordance with standard CALICO test procedures.

LOW LEVEL
WIDE RANGE

digital ohmmeter

Model 8303

FEATURES

- Ω 9 RANGES—1 OHM TO 100 MEGOHMS FULL SCALE
- Ω INPUT VOLTAGE PROTECTION TO 200 VDC OR PEAK AC
- Ω 5 DIGIT DISPLAY WITH 20% OVERRANGE
- Ω 4-WIRE KELVIN CLIP INPUT CABLE
- Ω HIGH COMMON MODE REJECTION
- Ω 100 MICRO-OHM RESOLUTION
- Ω ANALOG VOLTAGE OUTPUT
- Ω ACCURACY TO 0.02%

The California Instruments Model 8303 Digital ohmmeter is truly the World's most versatile ohmmeter. It has nine ranges from 1 ohm to 100 megohms full scale. The resolution of 0.01% displays 100 micro-ohms per digit on the most sensitive range with accuracy to within 3 digits.

This ohmmeter is completely protected against inadvertent voltage inputs. An input voltage of 200 VDC or peak AC will not damage the meter. The input circuits are electronically protected and, upon removal of the input voltage, recovery to full accuracy is instantaneous.

Kelvin-clip input cables provide resistance measurement independent of input cable resistance. The measurement is made at the contact point of the clips and the sample under measurement. There is no requirement for ohmmeter "zero" adjustments other than at the routine calibration/certification periods.

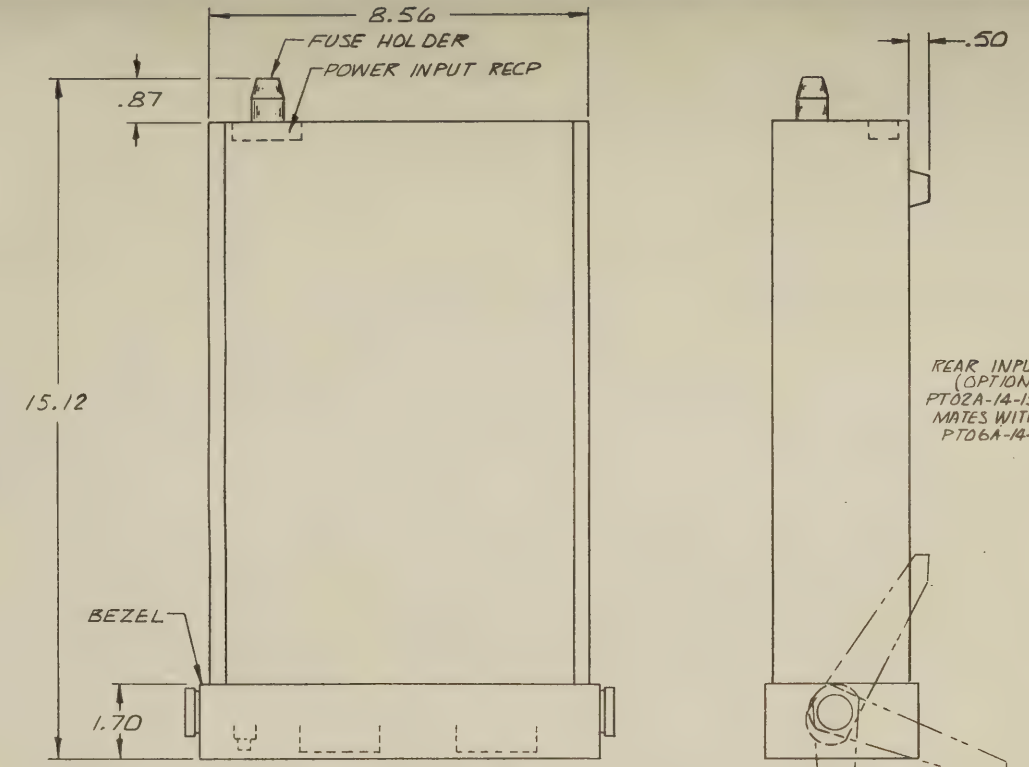
Pushbutton range selection affords a broader choice of resistance measurements than previously available in a single instrument. The construction features IC plug-in cards for ease of maintenance and calibration. The circuits are completely enclosed in an electronically guarded compartment to provide extremely high rejection for common mode voltages. The compartmentized AC power supply section provides operation completely free of AC line noise and transient interference.

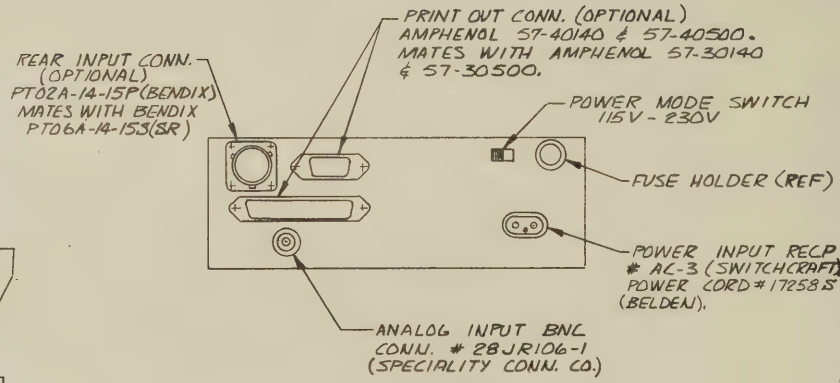
The readout features non-blinking/true-storage and large, easy-to-read neon numbers to prevent operator fatigue. BCD printout is available on an optional basis. The convenient analog voltage output which provides 10 volts full scale regardless of range (12 volts including overrange), may be used to drive recording equipment when a permanent record is quired. The versatility of this new ohmmeter, combined with the high accuracy and excellent performance, creates a new measurement tool ideally suited for receiving inspection, quality assurance, production testing, and engineering, as well as a component in systems and test consoles.

Represented by: DAMON / ENGEL Inc
P. O. Box 705, Ridgewood, N. J. 07451
212-732-0001 - 201-444-1400 - 215-922-3[illegible]

CALIFORNIA INSTRUMENTS

REVISIONS					
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

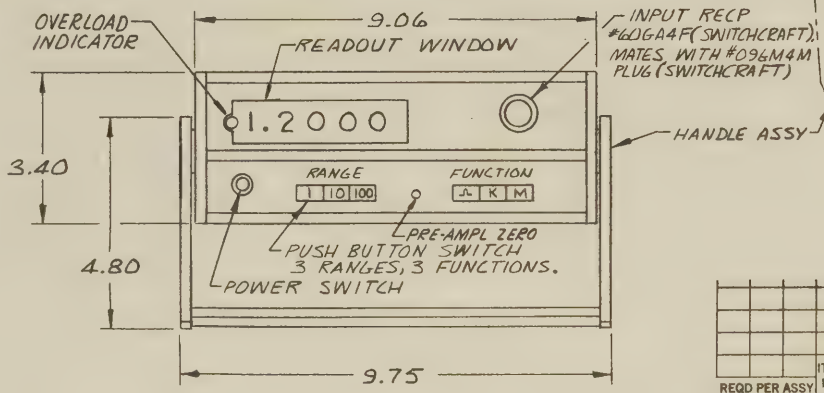



REAR INPUT CONN. (OPTIONAL) PT02A-14-15P(BENDIX) MATES WITH BENDIX PT06A-14-15S(SR)
PRINT OUT CONN. (OPTIONAL) AMPHENOL 57-40140 & 57-40500. MATES WITH AMPHENOL 57-30140 & 57-30500.
POWER MODE SWITCH 115V - 230V
FUSE HOLDER (REF)
POWER INPUT RECP # AC-3 (SWITCHCRAFT) POWER CORD # 17258 S (BELDEN).
ANALOG INPUT BNC CONN. # 28JR106-1 (SPECIALITY CONN. CO.)

REAR PANEL

REAR INPUT CONN. WIRING

PIN M	Hi INPUT
PIN R	CURRENT SOURCE
PIN N	Lo INPUT
PIN P	CURRENT RETURN
PINS A THRU K -	GUARD



8303 SHOWN

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH					

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓

DWG SIZE C

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TITLE: OUTLINE DRAWING, OHM METER

MODEL	8303			
RELEASE	[signature]	10/9		
CHECKER	[signature]		PURCHASING	
DESIGN			PROJ ENGR	
DRFTSMN	MARTIN	10-30-69	CHF ENGR	

CALICO
CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

CONTRACT NO.

CODE IDENT 16067

DWG NO. C8300-902

REV -

SCALE 1:2

SHEET 1 OF 1

C8300-902

NOTES: (UNLESS OTHERWISE SPECIFIED)

CALICO F-102

REVISIONS						
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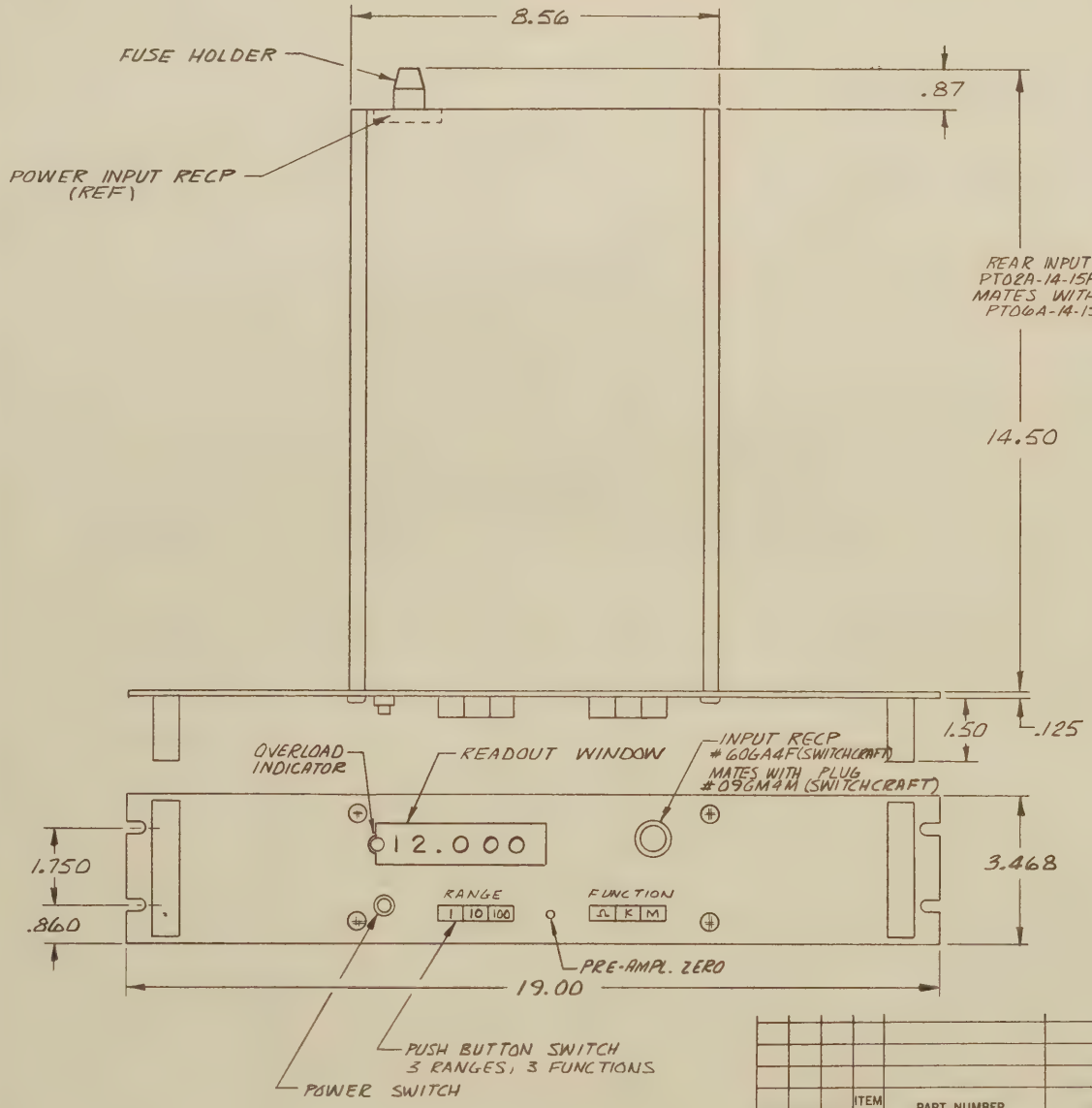
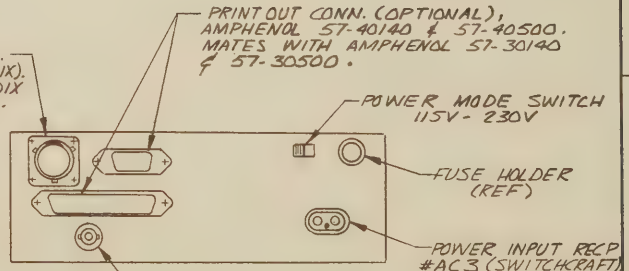


8303 R SHOWN


PRINT OUT CONN. (OPTIONAL), AMPHENOL 57-40140 & 57-40500. MATES WITH AMPHENOL 57-30140 & 57-30500.
POWER MODE SWITCH 115V - 230V
FUSE HOLDER (REF)
POWER INPUT RECP #AC3 (SWITCHCRAFT). POWER CORD#17258S (BELDEN).
ANALOG INPUT BNC RECP. SPECIALITY CONN CO # 28JR106-1

REAR PANEL

REAR INPUT CONN. WIRING	
PIN M	Hi INPUT
PIN R	CURRENT SOURCE
PIN N	Lo INPUT
PIN P	CURRENT RETURN
PINS A THRU K	GUARD

NOTES: (UNLESS OTHERWISE SPECIFIED)

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES
TOLERANCES
.XXX = .010
.XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES √

DWG SIZE C

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TITLE: OUTLINE DRAWING, OHMMETER, RACK MOUNT

MODEL 8303R

RELEASE	E Shuett	1/19/67	
CHECKER			PURCHASING
DESIGN			PROJ ENGR
DRFTSMN	MARTIN	10-30-67	CHF ENGR

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.

CODE IDENT 16067

DWG NO. C8300-903

REV -

SCALE 1:2

SHEET 1 OF 1

C8300-903 - B

INSTALLATION AND OPERATION

2.1 UNPACKING

This Ohmmeter is shipped in a cardboard container with a protective inner packing. Do not destroy the packing container until the unit has been inspected for possible damage in shipment.

2.2 POWER REQUIREMENTS

The unit operates from 115 VAC ±10 VAC or 230 VAC ±20 VAC at 50 to 400 Hz. The power consumption is less than 15 watts.

2.3 OPERATING CONTROLS

2.3.1 FRONT PANEL CONTROLS

2.3.1.1 RANGE SWITCH

The range switch is a three station, interlock, push button switch located on the left side of the front panel. The three ranges are 1, 10 and 100. These ranges are direct multipliers for the units of measure used on the function switch, i.e., 10Ω, 10KΩ, etc.

2.3.1.2 FUNCTION SWITCH

The function switch is a three station, interlock,push button switch located on the right side of the front panel. These functions are Ω, KΩ and MΩ.

2.3.1.3 FRONT PANEL ZERO CONTROL

The front panel zero control is used to zero the pre-amplifier. It, therefore, has the most effect when the preamplifier is used at its highest gain setting. The highest preamplifier gain setting is used on all Ω's ranges and the 1 KΩ range.

2.3.1.4 POWER SWITCH

The front panel power switch is a lighted push button type switch. It is a push for on -- push for off type action.

2.3.2 REAR PANEL CONTROLS

2.3.2.1 115-230 SWITCH

The rear panel 115-230 switch allows the 8303 to be operated from 115 volts AC or 230 volts AC. To operate from 115 volts AC, slide the switch to the 115V position and install a .2 amp slow blow fuse. To operate from 230 volts AC, slide the switch to 230V and install a .1 amp slow blow fuse.

2.4 ACCEPTANCE TEST PROCEDURE

Inspect the unit for any possible shipping damage immediately upon receipt. If any damage is evident, notify the carrier. Do not return the instrument to the factory without prior approval. If the unit appears to be in good condition, perform the following:

a) Connect a wattmeter between the AC power input to the digital ohmmeter and the AC line. Check that the 115-230 switch is in the desired position and the proper fuse is installed. Turn the unit on and check that the power does not exceed 15 watts. Allow 15 minutes for the digital ohmmeter to warm up.

b) Short all three input leads together. Select the KΩ function and the 100 range. Check that the display reads 00.000 ±1 digit.

c) Connect the 8303 input to a 100 KΩ .005% precision resistor. The 8303 should read 100.00 ±2 digits.

d) If further evaluation is required, see Section 4.2., Calibration Procedure.

2.5 INSTALLATION

The CALICO Model 8303 Digital Ohmmeter may be bench mounted or rack mounted. To rack mount, specify Option R Rack Mount Adapter. To bench mount, specify Option B Bench Mount Adapter.

Although no special cooling fans are required, the unit should be installed so that the flow of air is not obstructed. Care should also be taken not to install the unit in areas where excessive heat is produced by other equipment.

THEORY OF OPERATION

3.1 GENERAL

The CALICO Model 8303 Digital Ohmmeter uses a single ramp type digital voltmeter for the analog to digital converter. A block diagram which illustrates the theory of operation, is shown in Figure 2. A precision constant current source is connected to the voltmeter input. This precision current causes a voltage drop across the unknown resistance. This signal is applied to a solid state chopper stabilized preamplifier with gains of +1.0, +10.0, and +100.0. This provides a full scale input to the analog to digital converter of ±10 volts on all input ranges.

The voltage ramp is reset to approximately +15 volts at the start of each conversion sequence as shown in Figure 3. The negative slope of this precision ramp is determined by stable passive components and the semi-infinite gain of an operational integrator.

This precision voltage ramp drives the inverting inputs of two differential comparators. The non-inverting input to one comparator is driven by the unkown input signal through the input amplifier. The non-inverting input of the remaining comparator is grounded. Figure 3 illustrates the timing sequence for a -10 volt input signal.

The output of these comparators drive a dual exclusive or gate which generates a pulse-width modulated signal. The width of this pulse-width modulated signal is proportional to the amplitude of the input signal.

This pulse-width modulated signal is used to gate a crystal controlled clock. The resulting pulse train is fed into a digital counter to produce a numerical representation equivalent to the analog input. This number is transferred into a digital storage register upon receipt of a load register pulse. The output of this register drives a set of decoder drivers which in turn drive a set of nixie tubes.

The time base generator is used to determine the timing sequence throughout the digital multimeter.

3.2 DETAILED CIRCUIT DESCRIPTION

3.2.1 TIME BASE GENERATOR

The time base generator consists of a uni-junction transistor oscillator and associate wave shaping circuits located on the A2 assembly. A schematic diagram for this circuitry is shown on drawing E8300-071 and consists of transistor A2Q3, integrated circuit A2IC4 and associated components.

The uni-junction oscillator generates a non-symmetrical output which is used to divide the machine timing into two intervals, a restore time period and an encode time period. The charging time of the uni-junction oscillator, which determines the encode time period of the machine, is set by A2R18 and A2C5 and is approximately 200 milliseconds. The discharge time of the uni-junction oscillator, which determines the restore time period of the machine is set by A2R22 and A2C5 and is approximately 15 milliseconds.

The output of the uni-junction oscillator is applied to A2IC4 and Pin 12 where it is converted to a rectangular pulse by two successive invertors. The positive going, or leading edge, of this pulse is used to reset the ramp to approximately +15 volts. This signal is available at A2IC4 Pin 1 and is illustrated in Figure 3, waveform G. The load storage register signal is generated at A2IC4 Pin 2 and is illustrated in Figure 3, waveform I.

The decade counter reset pulse is generated at A2IC22 Pin 3 and is illustrated in Figure 3, waveform J. This pulse is approximately 0.1 microsecond behind the positive going edge of the load register pulse. The decade counter reset pulse is approximately 1 millisecond wide and is used to reset the decade counters back to zero.

3.2.2 INPUT AMPLIFIER

The input amplifier is a chopper stabilized potentiometric amplifier. A schematic diagram for this amplifier is located on drawing D8300-073. This amplifier is the A10 assembly.

This amplifier is divided into five sections; the modulator, the carrier amplifier, the demodulator, the output integrator and the oscillator driver.

The oscillator, A10IC2 and associated components, operates at a normal frequency of 525 Hz. This oscillator is a Wein Bridge type oscillator. The amplitude control is provided by means of two zener diodes A10CR9 and A10CR10. The output A10IC2 Pin 6 drives two drivers; the modulator driver A10Q3 and the demodulator driver A10Q5. The modulator driver produces a trapezoidal waveform swinging between 0 volts and +5.5 volts. The demodulator driver produces a square wave that swings between 0 volts and +8 volts.

The modulator A10Q2 is a MOSFET connected as a common source switch. The DC gate bias is derived from the same feedback point that the case and source are driven from. The gate drive signal is applied through A10C4. Any voltage difference between the feedback and the input will appear as a 525 Hz square wave at the drain lead of A10Q2.

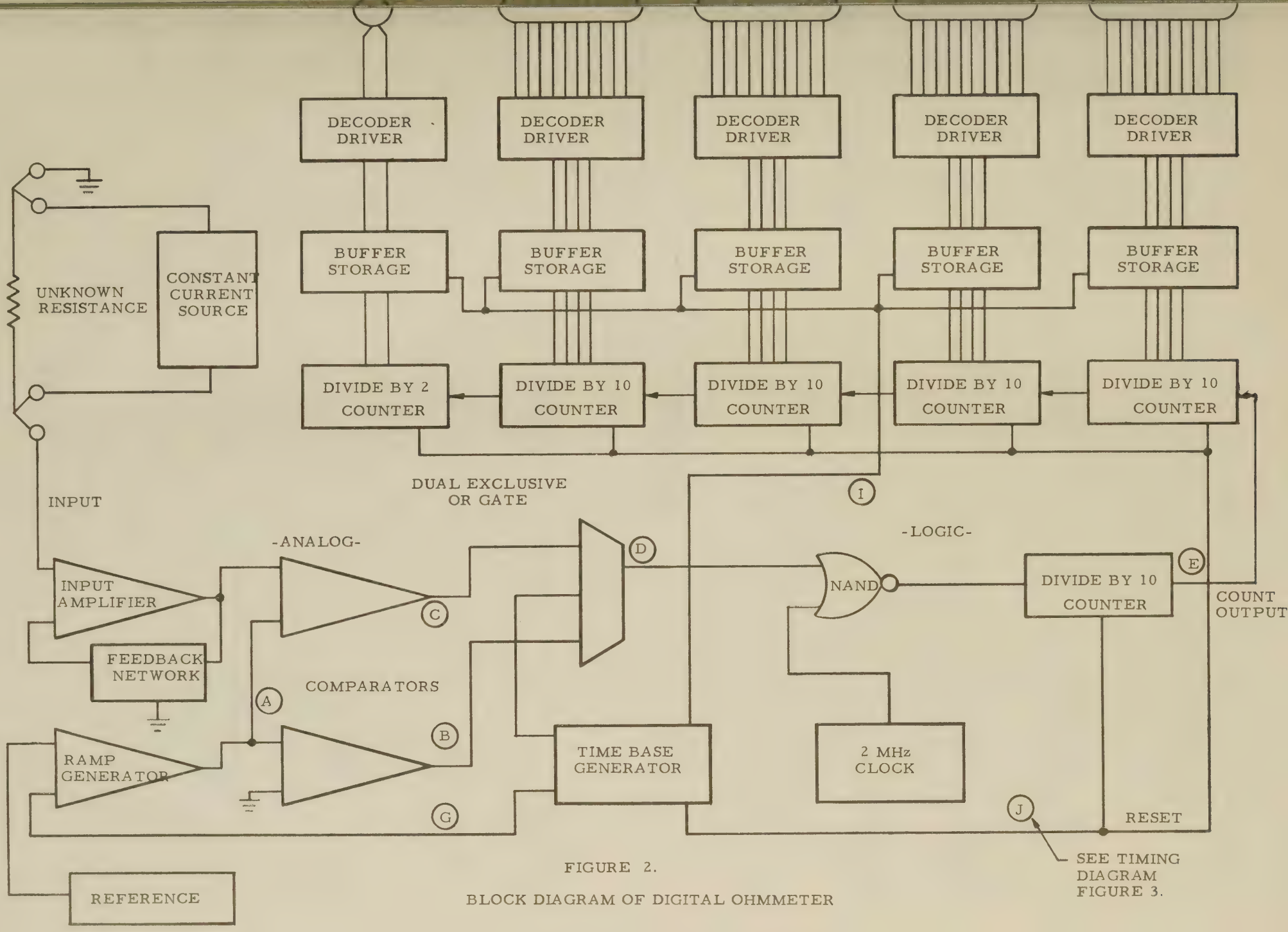


FIGURE 2.

BLOCK DIAGRAM OF DIGITAL OHMMETER

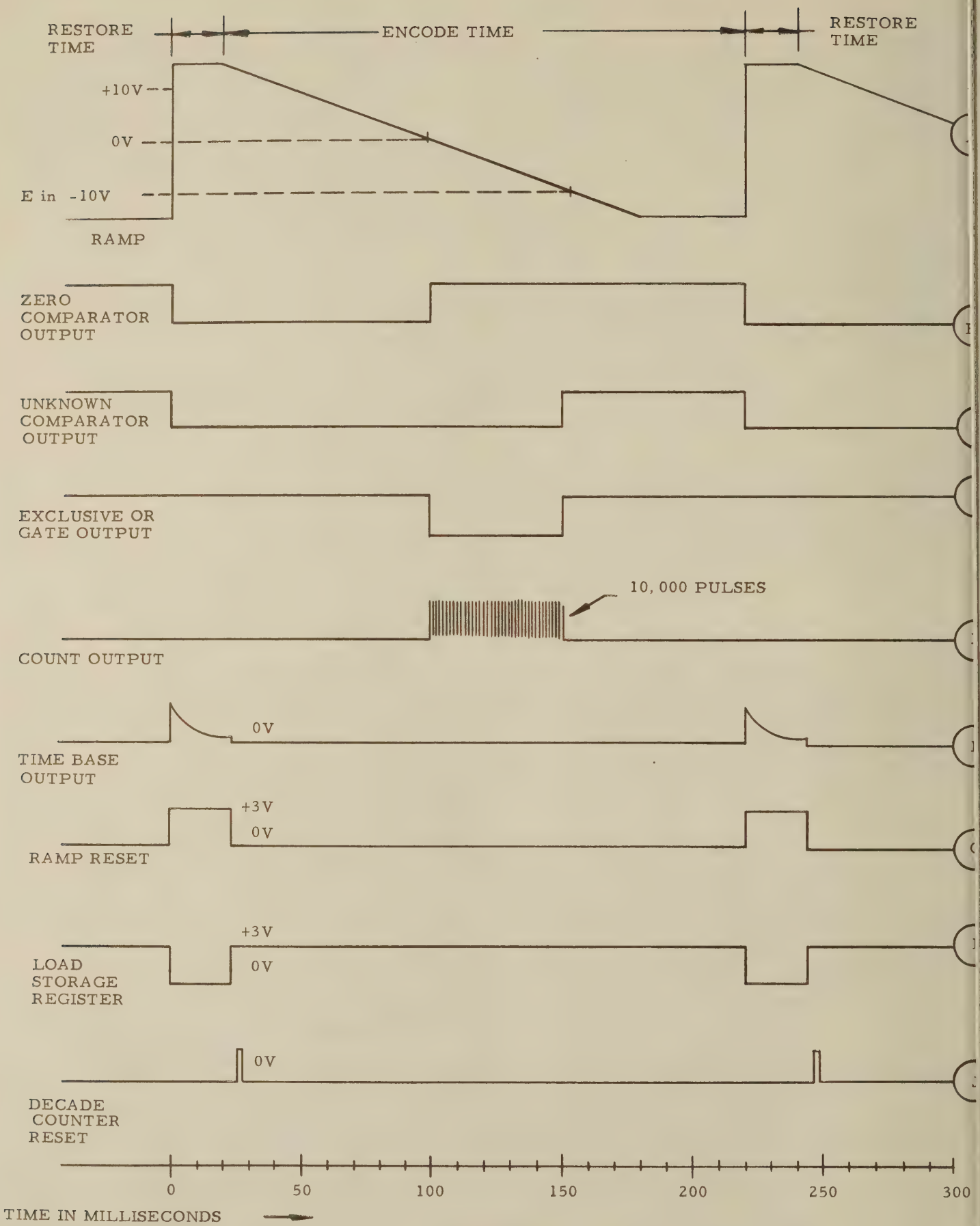


FIGURE 3.

INTERNAL WAVEFORMS
(REF. TO FIGURE 2)

This modulated signal is then fed into the carrier amplifier through A10C2. The carrier amplifier A10Q1 and A10IC1 is an AC coupled, non-innerting amplifier with a gain of approximately 1000 at 525 Hz.

The output of the carrier amplifier A10TP2 is applied to the demodulator through A10R15. The demodulator A10Q6 receives its base drive through A10CR5, A10CR6, A10CR7 and A10CR8 from the demodulator driver A10Q5.

The output of the demodulator drives the output integrator A10IC3 through A10R19. The output of the output integrator A10 Pin 10 is returned to one of three feedback loops A10 Pin 3, A10 Pin 4 or A10 Pin 5 by way of the push button switches on the master board A1. If the output A10 Pin 10 is connected to feedback point A10 Pin 3, 100 per cent of the output is returned as feedback giving a gain of +1.00. If the output A10 Pin 10 is connected to feedback point A10 Pin 4, 10 per cent of the output is returned as feedback giving a gain of +10.0. If the output A10 Pin 10 is connected to feedback point A10 Pin 5, 1 per cent of the output is returned as feedback giving a gain of +100.0.

The zeroing of the amplifier is accomplished by feeding a DC voltage into A10 Pin 1 from a front panel zero adjustment.

3.2.3 INPUT FILTER

The input filter A8 is a 5 pole active, notch/RC type. A schematic diagram is contained on drawing C8300-075.

The notch filter is formed by A8R2, A8R3, A8R5, A8R6, A8C1, A8C2 and A8C3. The RC section is formed by A8R1, A8R4 and A10C1. The input is applied at A8 Pin 4. Low frequency signals, DC to 50 Hz, are fed directly through to the output A8 Pin 5. Signals present at the output are applied to the input of the direct coupled amplifier A8Q1 gate. These signals are fed through the amplifier at a gainof .995 and reinjected into the notch through A8R6. As the input signal reaches 60 Hz, the phase shift in the notch is 180° thus causing the feedback to be out of phase with the input. This gives high rejection to frequencies around 60 Hz. Because the same DC voltage is present on both sides of the capacitors, no net change is produced thus eliminating the source impedance dependency of conventional notch filters. As the frequency is increased A8C1 and A8C3 become a low impedance by-pass for A8R2 and A8R3, thus leaving A8R1, A8R4 and A10C1 to form a simple RC section. This section starts to roll off around 30 Hz but does not become effective until it reaches 100 Hz. Overvoltage protection is provided by two low leakage diodes, A8CR1 and A8CR2, reverse biased to the power supplies.

3.2.4 RAMP GENERATOR

The ramp generator is located on the A2 assembly and a schematic diagram is shown in drawing E8300-071. This ramp generator consists of A2Q2, A2IC1 and associated components.

The ramp generator is an operational integrator which converts a precision input current into a linear voltage ramp. Transistor A2Q2 is a dual transistor used in the differential emitter follower configuration to provide a high input impedance at the summing point of the operational integrator. The output of this differential emitter follower is used to drive a high gain integrated circuit amplifier A2IC1. The output of A2IC1 is returned to the inverting input of A2Q2 through a precision integrating capacitor.

The precision input current to the ramp generator is determined by a zener diode reference and a series resistance to the summing point. The zener diode reference consists of A2Q1, A2CR1 and associated components. Transistor A2Q1 is used as a constant source of current which drives the zener reference A2CR1. The temperature coefficient of this zener reference is matched to the temperature coefficient of the precision integrating capacitor A2C1. This is accomplished by adjusting the value of resistor A2R6.

3.2.5 COMPARATORS

The comparators are located on the A2 assembly and a schematic diagram is shown in drawing E8300-071. The comparators A2IC3 and A2IC2 are high gain differential amplifiers. The inverting input to each comparator is driven from the ramp output through A2R15 and A2R16. The non-inverting input to A2IC3 is grounded through A2R3 and A2R19. The non-inverting input to A2IC3 is driven by the unknown input through A2R17 and A2R14 from the output of the input amplifier. Diodes A2CR6, A2CR7, A2CR8 and A2CR9 form input protection networks for the comparators.

As the ramp output becomes more negative than the non-inverting input of either comparator, this comparator output drives positive. The difference in time when one comparator output is driven positive and when the other comparator is driven positive is directly proportional to the analog input voltage.

Each comparator output drives an invertor located on the A2 assembly. These invertors A2IC5 are used to inhibit the comparator output during the ramp restore time interval.

3.2.6 DUAL EXCLUSIVE OR GATE

The dual exclusive or gate is located on the A2 assembly and a schematic diagram is shown in drawing E8300-071. This gate is driven from the invertors contained in integrated circuit A2IC5.

The dual exclusive or gate A2IC7 is comprised of four dual input nor gates. The purpose of this gate is to give an output only when a difference exists between comparator outputs. The block diagram and truth table per Figure 4 illustrate how this is accomplished.

3.2.7 2 MHz CRYSTAL OSCILLATOR

The 2 MHz crystal oscillator is located on the A2 assembly and a schematic diagram is shown in drawing E8300-071.

The function of the crystal oscillator is to provide a precision frequency which is used to accurately measure the pulse width of the dual exclusive or gate output.

The 2 MHz crystal oscillator consists of A2IC6, crystal A2Y1 and associated components. Resistors A2R27 and A2R28 provide a DC bias current to the two stage integrated circuit oscillator. The crystal is placed in the positive feedback loop of the oscillator.

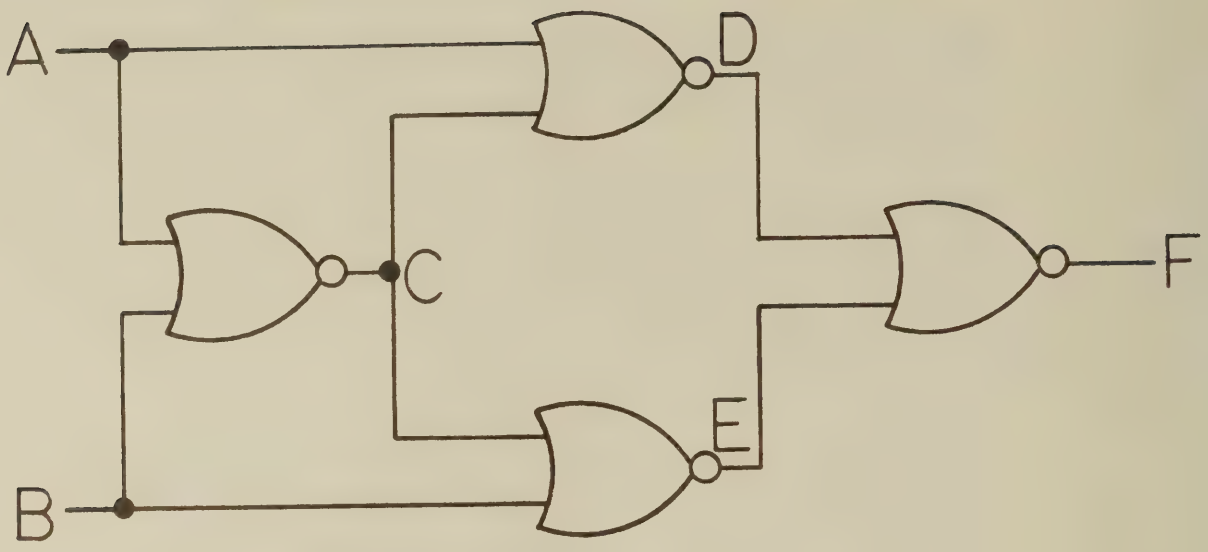
The output of the 2 MHz oscillator is gated with the output of the dual exclusive or gate and provides a 2 MHz pulse train at Pin 5 of A2IC4.

This 2 MHz pulse train drives a divide by ten integrated circuit counter A2IC11. The resulting 200 KHz pulse train output, at Pin 8 of A2IC11, is used to drive the decade counters.

3.2.8 DECADE COUNTER

Each decade contains an integrated circuit counter, storage register, decoder-driver and nixie display tube. A schematic diagram for the decade counter is shown in drawing E8300-071.

The 200 KHz pulse train is applied to the decade counter A2IC10 in the "units" decade. The count output of the "units" decade is used to drive the count input of the "tens" decade. In like manner, the output of the "tens" decade is used to drive the "hundreds" decade, etc. The total count is accumulated in all the decade counters before the end of the encode time as shown in Figure 3 waveform E.



TRUTH TABLE

POSITIVE "1" STATE

A	B	C	D	E	F
0	0	1	0	0	1
1	0	0	0	1	0
0	1	0	1	0	0
1	1	0	0	0	1

THE OUTPUT AT "F" IS TRUE ONLY WHEN A DIFFERENCE EXISTS BETWEEN POINTS "A" AND "B".

FIGURE 4.

TRUTH TABLE

At the start of the restore time, when the load storage register pulse goes to zero volts, the BCD number in each of the decade counters is transferred into the storage register A2IC9, A2IC13, etc.

The BCD outputs of each of the storage registers activate the corresponding decoder-drivers A2IC8, A2IC12, etc. The ten-line output of the decoder-drivers activates the nixie tubes DS-1, DS-2, etc.

At the conclusion of the restore time period, all decade counters are reset to zero and are ready to receive new data.

3.2.9 OVERRANGE

The overrange circuitry is located on the A2 assembly and a schematic diagram is shown in drawing E8300-071.

The overrange circuitry has two modes of operation. These are:

1) In the first mode, no count pulses are received from the last decade counter stage, and as a result, a zero occurs in the overrange indicator.

2) In the second mode, a single count pulse is received from the last decade counter, and as a result, a "1" indication occurs in the overrange indicator.

The operation of the overrange circuit can be explained as follows:

The count output of the last decade is applied to the input of an invertor A2IC22 Pin 14. This invertor output A2IC22 Pin 5 is applied to the clocked input of a JK flip-flop, A3IC21 Pin 6. During the preceeding "restore" portion of the time base, the reset input A2IC21 Pin 10 was driven positive thus forcing the output A2IC21 Pin 9 on to its low state. Since the steering inputs A2IC21 Pin 5 and 7 are unbiased, the next negative pulse at the clocked input A2IC21 Pin 6 will advance the output A21C21 Pin 9 to the high state.

Both outputs of this flip-flop A2IC21 Pins 8 and 9 are used to drive the steering inputs to the next flip-flop A21C21 Pins 1 and 3. At the conclusion of the "encode" portion of the time base, a load storage register pulse occurs. This pulse is applied to the clocked input A2IC21 Pin 2. Therefore, the second flip-flop stores the data gathered in the first flip-flop. The outputs of the second flip-flop A2IC21 Pins 13 and 14 are applied to the inputs of the two nixie drivers A2Q4 and A2Q5, which in turn drive the 0 and 1 indication of the ten thousands display A2DS5.

3.2.10 OVERLOAD INDICATOR

The overload indicator and associated circuitry are located on the A19 assembly and a schematic diagram is shown in drawing C8300-088.

The purpose of the overload indicator is to provide a visual indication when the linear input range has been exceeded. The overload indicator has two modes of operation. The first mode occurs on functions with a linear full scale of 11999. The second mode occurs on functions with a linear full scale of 19999.

In the first mode of operation, the overload indicator turns ON when the display reaches or exceeds 12000. This is done by gating the 10,000's "1" with the 1,000's "2", "4" and "8". The 10,000's "1" is fed into A19 Pin 10 where it drives the input of a nor gate A19IC1 Pin 1 used as an inverter. This output A19IC1 Pin 3 is applied to a second nor gate A19IC1 Pin 12 used as an inverter. Therefore, a "1" at A19 Pin 10 releases the output at A19IC1 Pin 14 to go positive if the output at A19IC1 Pin 8 is released.

The 1,000's "2", "4" and "8" are applied to the or gate formed by A19CR1, A19CR2, A19CR3 and A19Q1. The output of the or gate is fed through A19R1 to the input of a nor gate A19IC1 Pin 7 used as an inverter. The output of this nor gate A19IC1 Pin 5 is fed to an input of a second nor gate A19IC1 Pin 10.

Therefore, if the 10,000's display shows a 1 or higher and the 1,000's display shows a 2 or higher, the outputs that drive A19R6 will go positive providing base drive to A19Q2 turning the overload indicator A19DS1 on.

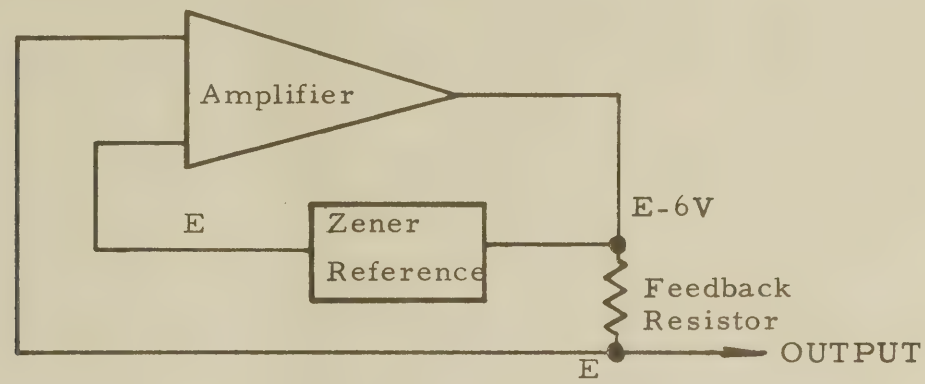
In the second mode of operation, the overload indicator turns on when the display exceeds 19999. To produce the second mode, the first mode must be disabled. This is done by applying +3.6V at A19 Pin 9 locking the output at A19IC1 Pin 8 in the "0" state. The second mode is produced when the 10,000's "1" is turned on and back off during a count sequence. The 10,000's output is applied at A19 Pin 2. This goes through an inverter and is applied at the input of a flip flop A19IC3 Pin 6.

If A19 Pin 2 is turned on and back off before a reset pulse appears at A19 Pin 11, the output of the flip flop will advance to the "1" state. If this flip flop is in the "1" state when the load register pulse appears at A19 Pin 1, the second flip flop will set to the "1" state. This "1" state output is fed through an inverter A19IC2 Pin 7 and into the base resistor A19R7 which turns the overload indicator on.

3.2.11 PRECISION CONSTANT CURRENT SOURCE

The precision constant current source is contained on the A17 assembly. A schematic diagram is contained on drawing number D8300-086.

The precision constant current source consists of a high gain direct coupled amplifier, a precision zener reference and a selectable feedback network.



CONSTANT CURRENT SOURCE -- Block Diagram

The direct coupled amplifier consists of a differential emitter follower pair, A17Q1, a high gain differential integrated circuit amplifier A17IC1 and an emitter follower A17Q4 driving a common emitter output stage A17Q5.

The amplifier output is applied to a floating precision reference supply. This precision reference supply is formed by driving a temperature compensated zener diode, A17CR16, from a transistor constant current source A17Q6. The nominal 6.3 volts DC provided by the precision zener is reduced by a resistive divider to produce 6.000 volts DC at the arm of A17R23.

This 6.000 volt reference voltage is then applied to the inverting input of the direct coupled amplifier. By connecting the non-inverting input of this amplifier, A17 Pin 10, back to the output of the amplifier through a precision resistor, a precision output current is produced. The current that flows in the output is the reference voltage divided by the feedback resistance.

3.2.12 POWER SUPPLY

The power supply is divided into five sections; the A11 assembly, the A12 assembly, the A13 assembly, the A16 assembly and the power transformer.

The A11 assembly provides ±15 volts DC. A schematic diagram is contained on drawing D8300-083. The unregulated ±24 volts enters the A11 board at Pins 5 and 1. This unregulated voltage originates on the A13 board at Pins 9 and 14. Because the two regulating sections on the A11 board are the same, the explanation will cover only the +15 volt regulator. The incoming +24 volt unregulated supply drives an integrated circuit amplifier A11IC1 Pin 7, a constant current source A11Q1, A11R1 and A11CR2, and an output driver A11Q3. The constant current source A11Q1 provides 4 MA to drive the two reference zener diodes A11CR7 and A11CR8. This provides +12 volts at Pin 3 of A11IC1. The regulated output at A11 Pin 4 is fed back to the inverting input of A11IC1 at Pin 2 through A11R11.

The resistive divider formed by A11R11 and A11R12 provides +12 volts at A11IC1 Pin 2 when the output is at +15. As the output load is increased, the output voltage becomes less positive causing A11IC1 Pin 2 to become more negative than Pin 3. This, in turn, causes the output of A11IC1 Pin 6 to drive more positive. As A11IC1 Pin 6 drives more positive, this increases the base drive to the output driver A11Q3 forcing its emitter more positive and restoring the output voltage. When the output load exceeds 180 MA, the excess base drive is pulled off the output driver through A11CR11 and A11CR13 limiting the maximum output current. This forms the short circuit protection for the regulator.

NOTE

If a short circuit is applied for more than 30 seconds, permanent damage may occur.

The A12 board provides +3.6 volts regulated output and +6.2 volts unregulated. A schematic diagram is contained on drawing C8300-082.

The A12 assembly contains a full wave silicon diode bridge rectifier A12CR1 through A12CR4, capacitive filter A12C1 and A12C2, and a high gain feedback type regulator. The power transformer A18T1 secondary 4 connects to the A12 board at Pins 1 and 3. From this the full wave silicon diode bridge and the capacitive filter provide +6.2 volts at A12 Pin 8. The integrated circuit amplifier A12IC1 operates off of +15, A12 Pin 5 and -15 volts A12 Pin 4. The output

A12 Pin 7 is fed back to the input of the amplifier A12IC1 Pin 2 through a resistive divider to the -15 volt supply. This produces 0 volts at the input when the output is +3.6 volts. If the output A12 Pin 7 becomes less positive, the input A12IC1 Pin 2 goes negative with respect to Pin 3. This drives the amplifier output A12IC1 Pin 6 more positive. In turn, The emitter of the pre-driver A12Q1 drives more positive, forcing the emitter of the output driver A12Q2 more positive, restoring the output voltage.

The A13 board contains 3 full wave silicon diode bridges and 4 output filters. A schematic diagram is contained on drawing C8300-081.

Transformer secondary A18T1-S1 connects to A13 Pins 6 and 7 and through a full wave silicon diode bridge, A13CR1 through A13CR4, to produce unfiltered +200 volts.

Transformer secondary A18T1-S2 is a center tapped winding that drives A13 Pins 10 and 11. The center tap ties to ground at A13 Pin 13. The full wave silicon diode bridge A13CR5 through A13CR8 provides ±24 volts into two filter capacitors A13C2 and A13C3.

Transformer secondary A18T1-S3 is connected to A13 Pins 3 and 4. The full wave silicon diode bridge A13CR9 through A13CR12 provides -22 volts into a capacitive output filter A13C4.

The A16 board contains a full wave silicon diode bridge and two capacitive output filters. A schematic diagram is contained on drawing B8300-087.

Transformer secondary A18T1-S5 is connected to A16 Pins 5 and 6. The full wave silicon diode bridge, A16CR1 through A16CR4, provides +30 and -33 volts into output filters A16C1 and A16C2.

POWER SUPPLY

Voltage	Tolerance	P-P Ripple	Ripple Freq	Voltage Available At:	Average Load Current
+15	±10%	8MV	5Hz ①	A11 Pin 4	62MA
-15	±10%	2MV	5Hz ①	A11 Pin 2	46MA
+24	±20%	1V	120Hz ②	A11 Pin 5	78MA
-24	±20%	.7V	120Hz ②	A11 Pin 1	52MA
+6.2	±20%	.4V	120Hz ②	A12 Pin 8	750MA
+3.6	±10%	2MV	5Hz ①	A12 Pin 7	700MA
+200	±20%	1V	120Hz ②	A13 Pin 8	12MA
-22	±20%	2V	120Hz ②	A13 Pin 5	10MA
+32 ③	±20%	.2V	5 Hz ①	A16 Pin 4	12MA
-30 ③	±20%	1V	120Hz ②	A16 Pin 1	120MA

All voltages and ripples are measured with 115 volts AC 60 Hz applied to the transformer primary.

① Ripple generated by 5 Hz conversion rate.

② Twice the line frequency.

③ Measured on 1Ω range with input shorted.

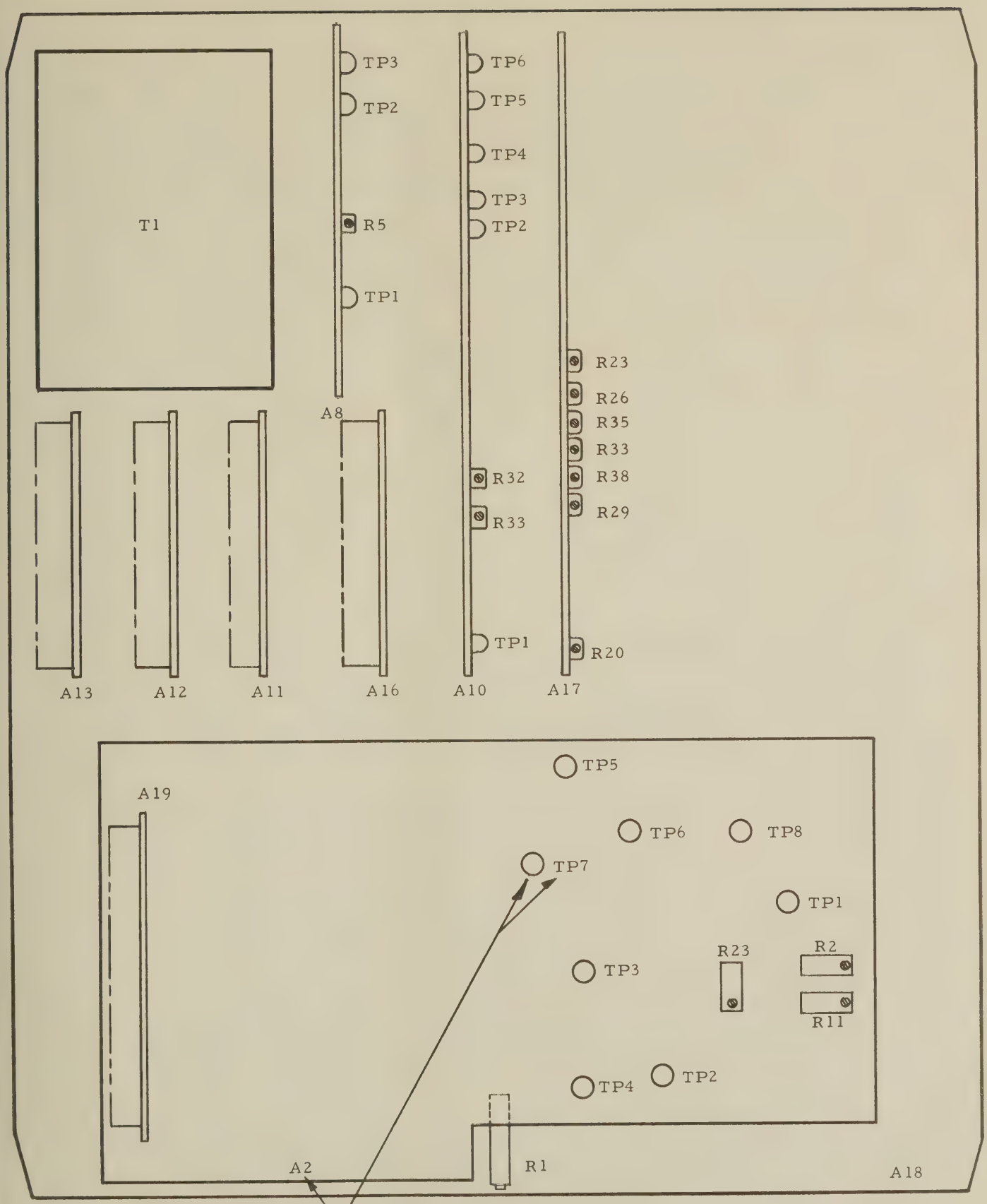


FIGURE 5. (TOP VIEW)
ADJUSTMENTS AND TEST POINTS

CALIBRATION PROCEDURE

4.1 TEST EQUIPMENT REQUIRED

a) Precision resistance standards

1. 1.0 ohms ±.005%
2. 10 ohms ±.005%
3. 100 ohms ±.005%
4. 1.0 kilohms ±.005%
5. 10 kilohms ±.005%
6. 100 kilohms ±.005%
7. 1.0 mehohm ±.005%
8. 10 megohms ±.01%
9. 100 megohms ±0.1%

b) AC Wattmeter: Triplett 661 or equivalent

c) Variac: Superior Electric 216 or equivalent

d) DC Voltage Standard: Kintel 331 or equivalent.

4.2 CALIBRATION PROCEDURE

The following calibration procedure may be performed on a routine basis to insure that the unit remains within the specified tolerances. This procedure should always be performed after any repairs are made on the basic accuracy determining circuitry. Before calibrating the unit, apply AC power and allow a minimum of one hour to permit the internal circuitry to stabilize.

This procedure covers the following adjustments:

a) Zero adjustment of A-D Converter

b) Zero adjustment of input amplifier

c) Calibration of A-D Converter

d) Calibration of input amplifier

e) Calibration of constant current sources

f) Input filter adjustment.

The calibration procedure should be performed as follows:

4.2.1 Select the KΩ function and the 100 range. Short the input leads together. Adjust A2R23 to give 000.00 in the display.

4.2.2 Select the KΩ function and the 1 range. Short the input leads together. Adjust the front panel zero control A18R1 to produce 0.0000.

4.2.3 Select the KΩ function and the 100 range. Remove the 0.2A signal fuse A18F2 located on the master board. Connect the 8303 input leads to the output of a precision DC voltage standard. Apply an input of +10.000 volts DC ±.003%. Adjust A2R2 until the display reads 100.00. Apply an input of -10.000 volts DC ±.003%. Adjust A2R11 until the display reads 100.00.

4.2.4 Replace the 0.2A signal fuse A18F2 on the master board. Connect the 8303 input leads to a 100KΩ precision resistance standard. Record the reading.

4.2.5 Select the 10 range. Connect the 8303 input leads to a 10 KΩ precision resistance standard. Adjust A10R32 until the display reads the same number obtained in Step 4.2.4.

4.2.6 Select the 1 range. Connect the 8303 input leads to a 1KΩ precision resistance standard. Adjust A10R31 until the display reads the same number obtained in Step 4.2.4.

4.2.7 Select the Ω function and the 1 range. Connect the input to a 1.0Ω precision resistance standard. Adjust A17R23 until the display reads 1.0000Ω.

4.2.8 Select the 10 range. Connect the input to a 10Ω precision resistance standard. Adjust A17R20 until the display reads 10.000.

4.2.9 Select the 100 range. Connect the input to a 100Ω precision resistance standard. Adjust A17R29 until the display reads 100.00.

4.2.10 Select the 1 range and the KΩ function. Connect the input to a 1.0KΩ precision resistance standard. Adjust A17R26 until the display reads 1.0000.

4.2.11 Select the 100 range. Connect the input to a 100KΩ precision resistance standard. Adjust A2R2 until the display reads 100.00.

4.2.12 Select the 1 range. Connect the input to a 1KΩ precision resistance standard. Adjust A10R31 until the display reads 1.0000.

NOTE

Steps 4.2.11 and 4.2.12 interact. It may be necessary to repeat these steps more than once.

4.2.13 Select the 10 range. Connect the input to a 10KΩ precision resistance standard. Adjust A10R32 until the display reads 10.000.

4.2.14 Select the MΩ function and the 1 range. Connect the input leads to a 1MΩ precision resistance standard. Adjust A17R38 until the display reads 1.0000.

4.2.15 Select the 10 range. Connect the input leads to a 10MΩ precision resistance standard. Adjust A17R33 until the display reads 10.000.

4.2.16 Select the 100 range. Connect the input leads to a 100 MΩ precision resistance standard. Adjust A17R35 until the display reads 100.00.

4.3 TEST PROCEDURE

The following test procedure, or any part of it, may be performed as required. This procedure should only be performed after completing 4.2 CALIBRATION PROCEDURE. This test procedure covers the following specifications for the digital ohmmeter:

1. Temperature coefficient
2. Stability
3. Input Overload
4. Line Voltage Range
5. Reading Rate

4.3.1 TEMPERATURE COEFFICIENT

Allow the machine to warm-up for one hour at room temperature, 25°C, and check the full scale calibration as given in the calibration adjustment procedure. Place the unit in an environmental chamber and raise the temperature to 50°C. Allow the unit at least one hour to stabilize at 50°C and then check the calibration. The allowable full scale excursion for the Model 8303 is ±7.5 digits at full scale, after zeroing at 50°C if required, on the 1Ω through the 100KΩ ranges. It is ±17 digits on the 1MΩ range, ±37 digits on the 10MΩ range and ±275 digits on the 100MΩ range.

4.3.2 TIME STABILITY

Allow the 8303 to stabilize at 25°C for two hours. Connect the input to a precision full scale resistance source. Monitor the 8303 display for a 24 hour period at 25°C. The allowable excursion is: ±2 digits on the 1Ω through the

100KΩ ranges; ±5 digits on the 1MΩ range; ±10 digits on the 10MΩ range; and ±100 digits on the 100MΩ range.

4.3.3 INPUT OVERLOAD

Select the 100 range and the KΩ function. Connect the input to a 100KΩ precision resistance standard. Record the reading. Apply an input of 115 VAC 60 Hz. Reconnect the input to the precision resistor. The unit should return to the original reading ±2 digits within 30 seconds.

4.3.4 LINE VOLTAGE RANGE

The following line voltage test are made around 115 volts AC 60 Hz. If the unit is used on 230 volts AC or other than 60 Hz the test should be run at that voltage or frequency.

Connect the variac to the 115 volts AC 60 Hz line. Connect the wattmeter/voltmeter to the output of the variac and connect the 8303 to the wattmeter/voltmeter output. Apply a full scale input resistance to the 8303. Vary the line voltage from 105 to 125 volts AC and check that the total variation does not exceed: ±2 digits on the 1Ω through 1MΩ ranges; ±4 digits on the 10MΩ range and ±10 digits on the 100MΩ range.

4.3.5 READING RATE

Connect an oscilloscope to TP7 of the A2 board. Check that the pulses occur at 180 to 250 millisecond intervals.

MAINTENANCE AND TROUBLESHOOTING

5.1 GENERAL MAINTENANCE

The CALICO 8303 Digital Ohmmeter is a solid state instrument designed to give years of trouble free service. Since the instrument has no moving parts, maintenance is limited to periodic cleaning in accordance with good commercial shop practices.

5.2 TROUBLESHOOTING

Experience has shown that often the difficulties encountered with equipment are poor input signals or misinterpretation of specifications. Check to be sure that the input is not noisy or erratic, and that you fully understand the characteristics of this instrument as defined in the specifications.

Only skilled personnel who have studied the theory of operation section of this manual should attempt to repair the instrument.

First check the power supplies per the table at the end of the power supply section, 3.2.12.

If the problem is not in the power supply section of the machine, check that the waveforms shown in Figure 3 are correct.

1. The ramp output is available at A2IC1 Pin 6.
2. The comparator outputs are available at A2IC2 Pin 6 and A2IC3 Pin 6.
3. The exclusive or gate output is available at A2IC7 Pin 5.
4. The count pulse train is available at A2IC4 Pin 5.
5. The time base output is available at A2TP7.
6. The load storage register signal is available at A2IC22 Pin 5.
7. The decade counter reset signal is available at A2IC22 Pin 3.

CIRCUIT DIAGRAMS

6.1 GENERAL

This section contains schematics and mechanical diagrams necessary for operation and maintenance of the Model 8303 Digital Ohmmeter. The schematic diagrams illustrate the circuit while the mechanical assemblies indicate the part placement.

(Applicable illustrations to the appendix sections are contained therein, not in this section.)

6.2 REFERENCE DESIGNATIONS

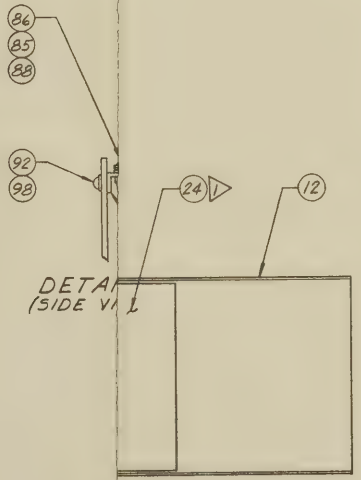
Partial reference designators are shown on schematics and mechanical drawings. Prefix these reference designators with assembly and/or sub-assembly designation for the complete reference designator. For example:

ASSEMBLY/SUB-ASSEMBLY	COMPONENT	COMPLETE DESIGNATION
A1	R1	A1R1
A7	C10	A7C10
A10	IC2	A10IC2

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

RECEPTACLE
USE HARDWAR

VIEW
B PANEL
NOT SHOWN FOR CLARITY



E VIEW TOP COVER
VO SCALE)

INSIDE VIEW BOT. COVER
(NO SCALE)

3 SOLDER OTHER

2 REMOVE JUMPE
PRINT BOARD

1 APPLY TO SUB

NOTES: (UNLESS OTHERWISE

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
-1		PL8300-404	PARTS LIST	SHEETS 3,4 & 5				

DIM IN INCHES
TOLERANCES
.XXX = .010
.XX = .03
X° = ± 30'

BREAK ALL SHARP CORNERS & EDGES
"MACH" SURFACES" ✓

DWG SIZE E

TITLE
ASSEMBLY DRAWING
DIGITAL OHMMETER

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

MODEL 8303
RELEASE E Sipley 7/5/
CHECKER
DESIGN
DRFTSMN

PURCHASING
PROJ ENGR
CHF ENGR

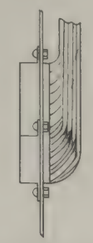
CONTRACT NO
CODE IDENT 16067

DWG NO E8300-404 B
REV
SCALE 1/1
SHEET 2 OF 5

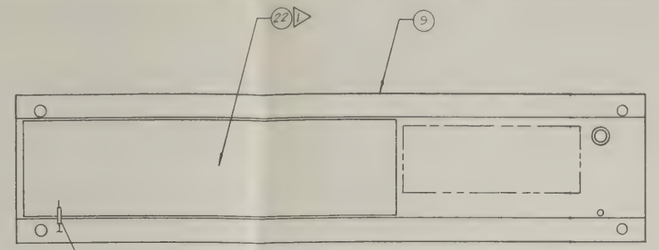
DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

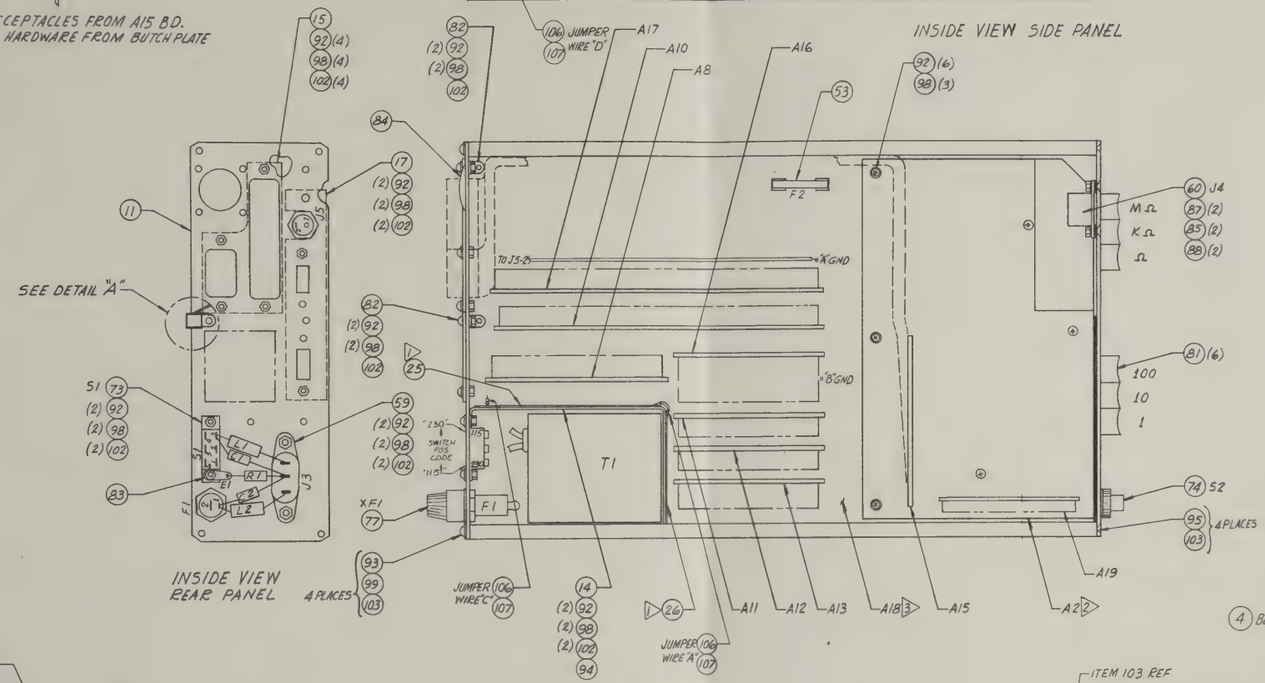
GALICO P-104

E8300-404 B

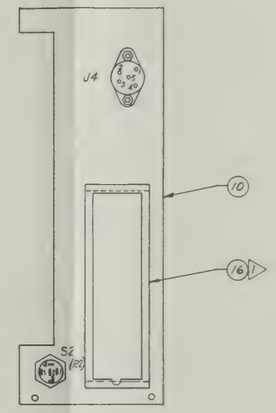


RECEPTACLES FROM A15 BD.
USE HARDWARE FROM BUTCH PLATE



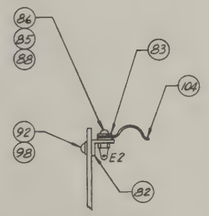


INSIDE VIEW
REAR PANEL

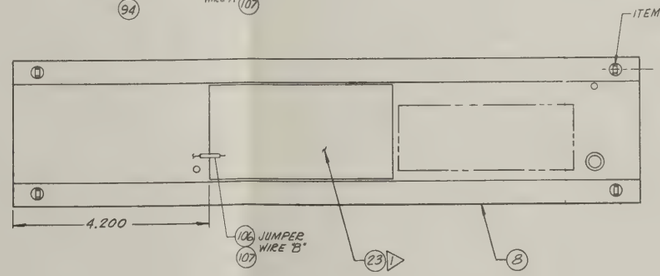


INSIDE VIEW
FRONT SUB PANEL

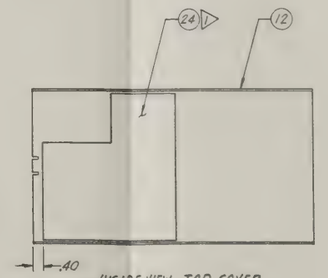
4 BEZEL ASSY NOT SHOWN FOR CLARITY



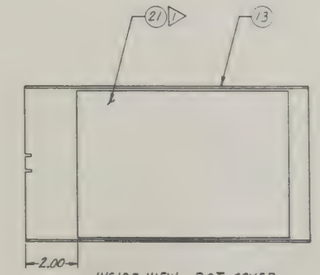
DETAIL "A"
(SIDE VIEW)



INSIDE VIEW SIDE PANEL



INSIDE VIEW TOP COVER
(NO SCALE)



INSIDE VIEW BOT. COVER
(NO SCALE)

JUMPER WIRE TABLE

WIRE A	B300-719	B300-720	SLEEVED BUSS
WIRE B	B300-720	B300-717	SLEEVED BUSS
WIRE C	B300-719	A18-18	SLEEVED BUSS
WIRE D	B300-716	A18-20	SLEEVED BUSS

WIRE TAB TABLE

WIRE #	FROM	TO	COLOR	
1	T1-PRI	S1-3	WHT	EXISTING XFORMER WIRES
2	T1-PRI	S1-5	BLK	
3	T1-PRI	S1-2	WHT	
4	T1-PRI	S1-4	BLK	
5	S2-1	S1-4	RED	3 COND. SHLD.
6	S2-2	F1-2	BLK	SHLD. TO E1 GND LUG
7	S2-4	S1-2	WHT	
8	S2-5	S2-1		RESISTOR R5 1806
9	J4-1	A18-16	SLEEVED BUSS	
10	J4-2	A18-15		
11	J4-3	A18-13		
12	J4-4	A18-17		
13	J4-5	A18-14		
14	E2	A18-19		
15	S1-1	S1-6	SLEEVED BUSS	
16	T1-SEC 3 OUTER SHLD	ITEM 23, B300-717	PIGTAIL	
17	J5-1	A18-33	SLEEVED BUSS	
18	J5-2	'A' GND	SLEEVED BUSS	
19				

3 SOLDER OTHER END OF FLEX PRINT TO A2 BOARD.

4 REMOVE JUMPER WIRE BETWEEN A2-4 & A2-5 WHEN PRINT BOARD A15 IS BEING USED.

5 APPLY TO SUB PANEL USING DOUBLE-BACK TAPE

NOTES: (UNLESS OTHERWISE SPECIFIED)

PL B300-404 PARTS LIST SHEETS 3,4 & 5

ITEM NO. / REQD PER ASSY	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES TOLERANCES: .XXX ± .010, .XX ± .03, .X ± .09. BREAK ALL SHARP CORNERS & EDGES. MARK SURFACES √

SIZE E

TITLE: ASSEMBLY DRAWING DIGITAL OHMMETER

CALICO — CALIFORNIA INSTRUMENTS COMP. SAN DIEGO, CALIFORNIA

MODEL B303 — CONTRACT NO. — CODE IDENT 16067

RELEASE 5-Sept 1974 — CHECKED — PURCHASING — DWG NO. E8300-404 — REV B

DESIGN — PROJ. ENGR — SCALE 1/1 — SHEET 2 OF 5

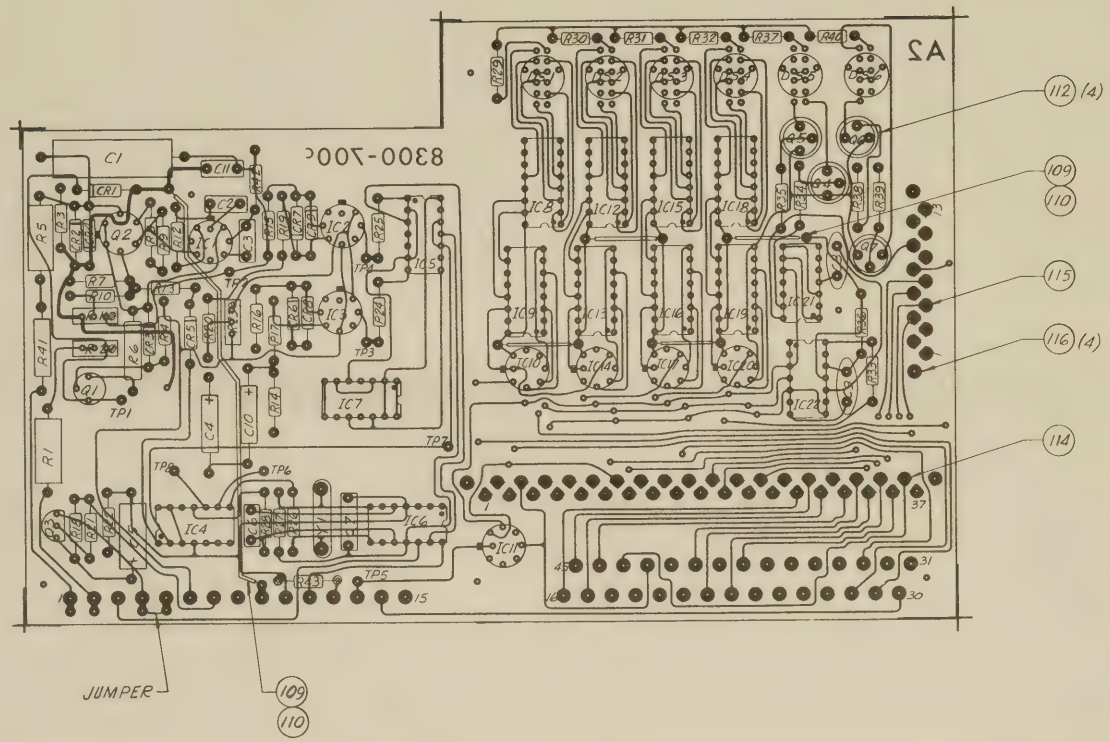
DRFTSMN — CHF. ENGR

DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF. ON | AUTH

E8300-404 B

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRO-DUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



A2
-1 ASSEMBLY
VIEW COMPONENT SIDE

1. FOR SCHEMATIC SEE DWG. No. 8300-071 SHEETS 1, 2 & 3.

NOTES: (UNLESS OTHERWISE SPECIFIED)

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES	ZONE
		PLB300-700	PARTS LIST	SHEETS 4 & 5				

DIM IN INCHES TOLERANCES XXX = .010 XX = .03 X° = 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES √
DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

DASH NO	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

TITLE: ANALOG & DECADE P.C. BOARD ASSEMBLY (A2)

MODEL	8300			
RELEASE	E. SHULTZ	2/17/9		
CHECKER	J. WENER	2/12/9	PURCHASING	
DESIGN			PROJ ENGR	G.T. 3/11/9
DRFTSMN	T. BROWN	1/22/9	CHF ENGR	

CALICO
CALIFORNIA INSTRUMENTS CORP
SAN DIEGO, CALIFORNIA

CONTRACT NO. | CODE IDENT 16067

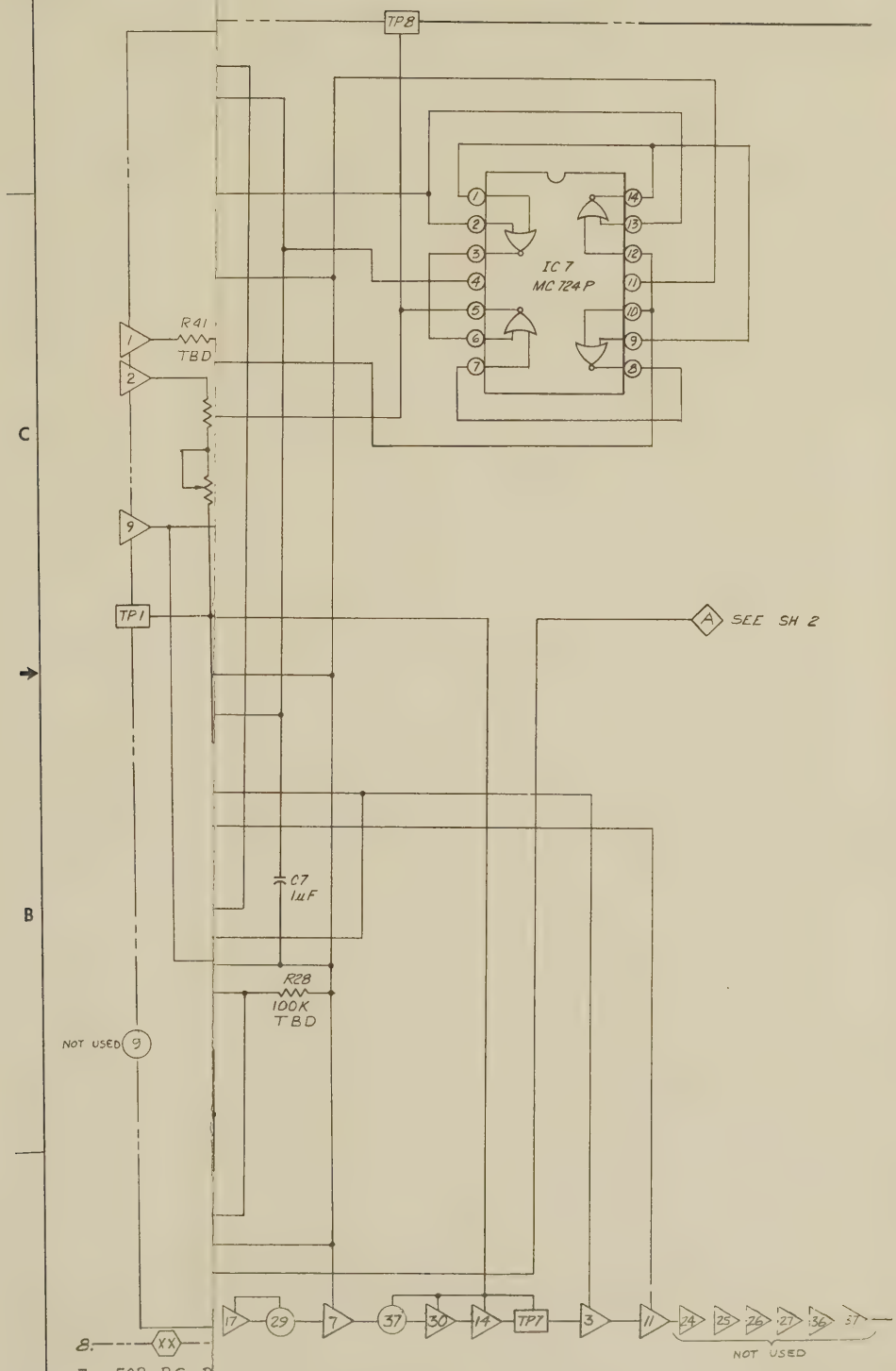
DWG NO. D8300-700 | REV B

SCALE 2/1 | SHEET 2 OF 7

CAL CO F 310

D8300-700 B

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD
A	D.C.	GEN CLEAN UP (Brown)			3/10/69	- 1
B	E.O. D.C.	INCORP. E.O. 283 & 278 ADDED ELCO CONT. FOR A19 P.C.BD. & NOTE 8. (W)			6-16-69	
C	D.C.	GEN CLEAN-UP INPUT PINS			11/6/69	JC



ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
REQD PER ASSY							

DIM. IN INCHES TOLERANCES: XXX ± .010, XX ± .03, X ± 1°. BREAK ALL SHARP CORNERS & EDGES MACH SURFACES. DWG SIZE: E

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

TITLE: SCHEMATIC - DECADE & ANALOG DIAGRAM (A2)

MODEL 8300 | RELEASE | CHECKER | DESIGN | DRFTSMN J. Kelly 1/9/69 | PURCHASING | PRO. ENGR G.T. 1-9-69 | CHF ENGR

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

CONTRACT NO. | CODE IDENT 16067

DWG NO. E8300-071 | REV C

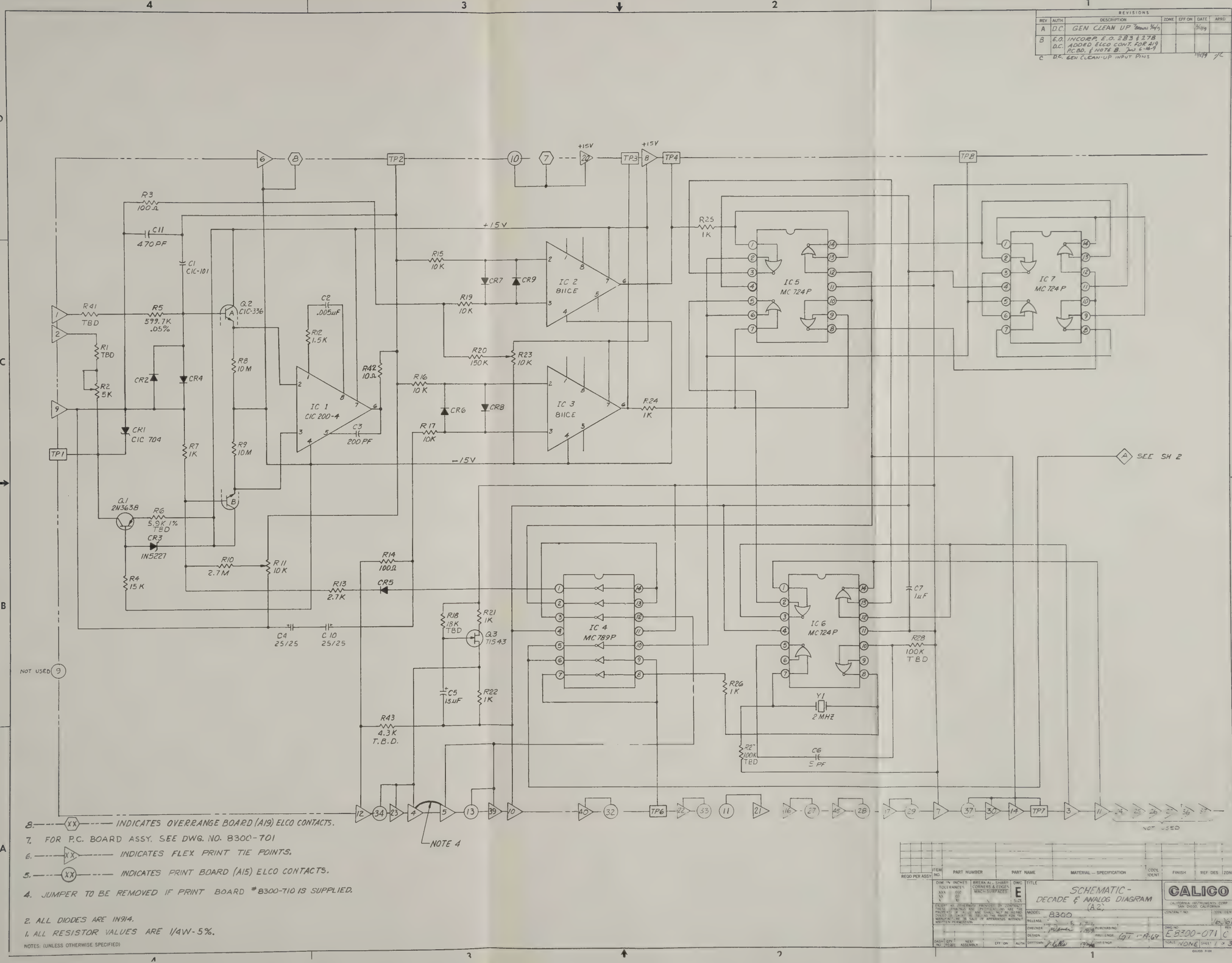
SCALE NONE | SHEET 1 OF 3

DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

CALICO P-1691

E8300-071 C

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APPR'D
A	D.C.	GEN CLEAN UP			3/4/69	
B	E.O. D.C.	INCORP. E.O. 283 & 278 ADDED ELCO CONT. FOR A19 P.C.BD. & NOTE 8.			6-18-69	
C	D.C. GEN CLEAN-UP INPUT PINS				11-4-69	JC



8. XX INDICATES OVERRANGE BOARD (A19) ELCO CONTACTS.
7. FOR P.C. BOARD ASSY. SEE DWG. NO. 8300-701
6. XX INDICATES FLEX PRINT TIE POINTS.
5. XX INDICATES PRINT BOARD (A15) ELCO CONTACTS.
4. JUMPER TO BE REMOVED IF PRINT BOARD #8300-710 IS SUPPLIED.
2. ALL DIODES ARE IN914.
1. ALL RESISTOR VALUES ARE 1/4W-5%.

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES	ZONE

REQD PER ASSY

DIM IN INCHES TOLERANCES: XXX .005, XX .01, X .1, ANGLES 1°. BREAK ALL SHARP CORNERS & EDGES. MACH SURFACES 63

DWG SIZE: E

TITLE: SCHEMATIC - DECADE & ANALOG DIAGRAM (A2)

MODEL: 8300

RELEASED: 5-7-69

CHECKED: 5-7-69

DESIGN: 1-14-69

DRAFTSMAN: 1-14-69

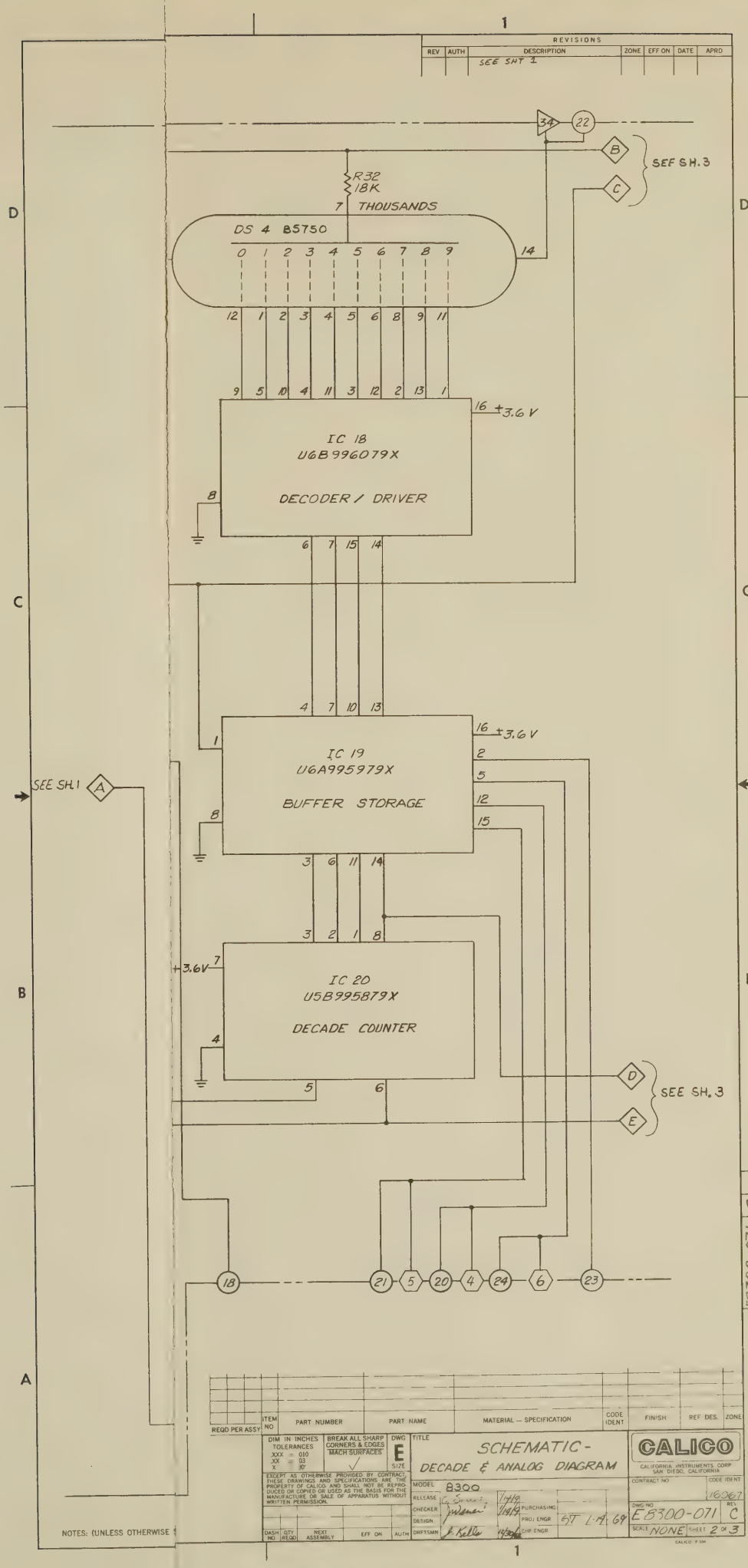
CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

CONTRACT NO. — SIZE IDENT: 16367

DWG NO: E8300-071 REV: C

SCALE: NONE SHEET: 1 OF 3

PART NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH


REVISIONS
REV | AUTH | DESCRIPTION | ZONE | EFF ON | DATE | APRD
SEE SHT 1
34
22
B
C
SEE SH. 3
R32
18K
7 THOUSANDS
DS 4 B5750
0 1 2 3 4 5 6 7 8 9
14
12 1 2 3 4 5 6 8 9 11
9 5 10 4 11 3 12 2 13 1
16 +3.6 V
IC 18
U6B996079X
DECODER / DRIVER
8
6 7 15 14
4 7 10 13
1
16 +3.6 V
IC 19
U6A995979X
BUFFER STORAGE
2
5
12
15
8
3 6 11 14
3 2 1 8
SEE SH. 1
A
+3.6V
7
IC 20
U5B995879X
DECADE COUNTER
4
5
6
D
E
SEE SH. 3
18 21 5 20 4 24 6 23
ITEM NO | PART NUMBER | PART NAME | MATERIAL — SPECIFICATION | CODE IDENT | FINISH | REF DES. | ZONE
REQD PER ASSY
DIM IN INCHES TOLERANCES XXX ± 010 XX ± 03 X 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES
DWG SIZE E
TITLE
SCHEMATIC -
DECADE & ANALOG DIAGRAM
CALICO
CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA
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MODEL 8300
CONTRACT NO
CODE IDENT 16067
RELEASE
CHECKER
DESIGN
DRFTSMN
PURCHASING
PROJ ENGR
CHF ENGR
DWG NO E8300-071
REV C
SCALE NONE
SHEET 2 OF 3
DASH NO | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH
NOTES: (UNLESS OTHERWISE
E8300-071 C

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRO
		SEE SHT 1				

R29 18K — 7 UNITS — DS 1 B5750 — 0 1 2 3 4 5 6 7 8 9

R30 18K — 7 TENS — DS 2 B5750 — 0 1 2 3 4 5 6 7 8 9

R31 18K — 7 HUNDREDS — DS 3 B5750 — 0 1 2 3 4 5 6 7 8 9

R32 18K — 7 THOUSANDS — DS 4 B5750 — 0 1 2 3 4 5 6 7 8 9

IC 8	U6B996079X	DECODER / DRIVER
IC 12	U6B996079X	DECODER / DRIVER
IC 15	U6B996079X	DECODER / DRIVER
IC 18	U6B996079X	DECODER / DRIVER
IC 9	U6A995979X	BUFFER STORAGE
IC 13	U6A995979X	BUFFER STORAGE
IC 16	U6A995979X	BUFFER STORAGE
IC 19	U6A995979X	BUFFER STORAGE
IC 10	U5B995879X	DECADE COUNTER
IC 14	U5B995879X	DECADE COUNTER
IC 17	U5B995879X	DECADE COUNTER
IC 20	U5B995879X	DECADE COUNTER
IC 11	U5B995879X	DECIMAL COUNTER

+3.6 V

SEE SH.1 (A)

(B) (C) SEE SH. 3

(D) (E) SEE SH. 3

TP5 13 2 1 6 5 31 8 7 15 14 31 14 17 16 19 18 21 5 20 4 24 6 23

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF. DES.	ZONE

REQD PER ASSY

DIM IN INCHES TOLERANCES XXX = .000 XX = .03 X = .1 — BREAK ALL SHARP CORNERS & EDGES MACH FINISH/DEBUR

SIZE E

TITLE: SCHEMATIC - DECADE & ANALOG DIAGRAM

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

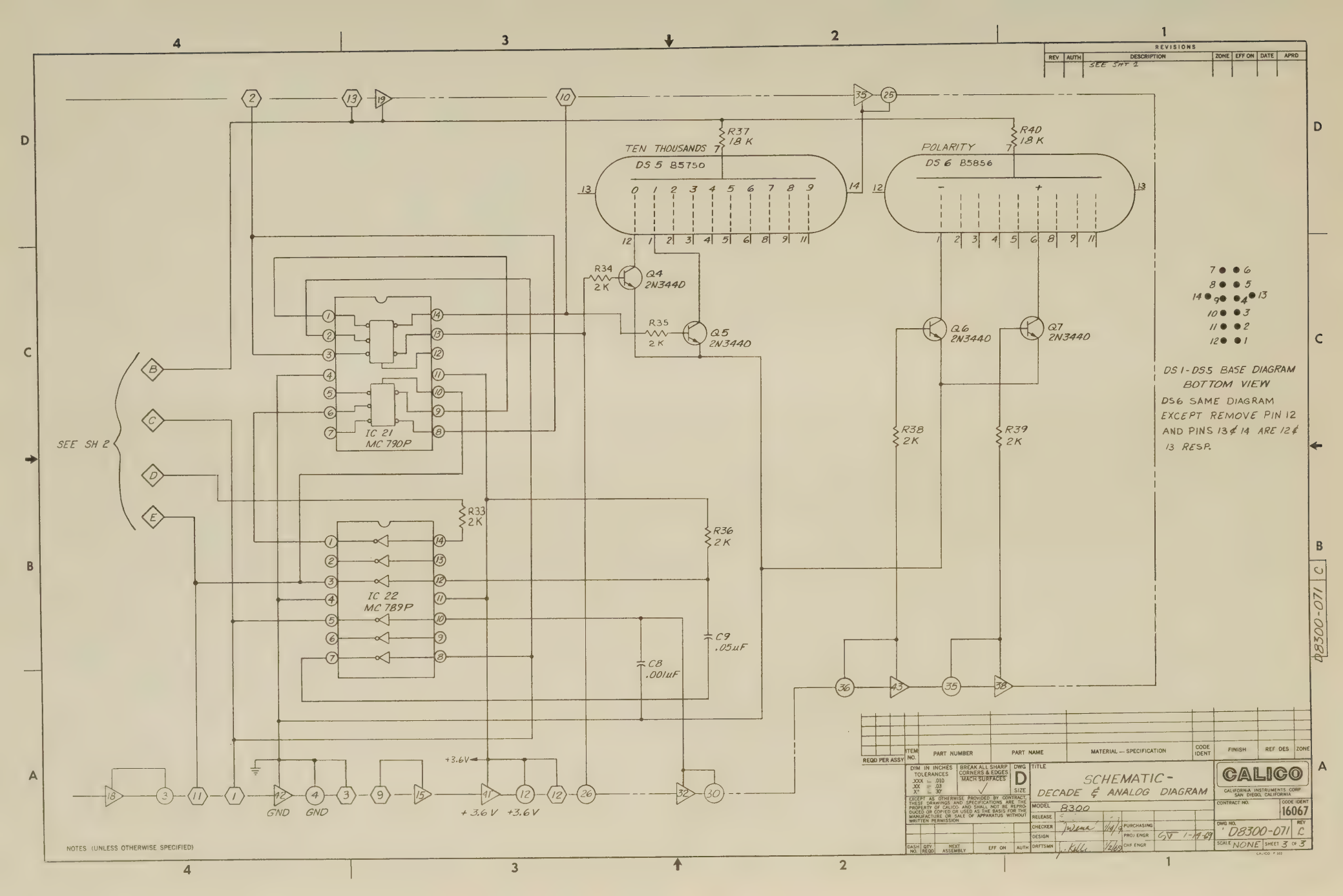
MODEL 8300 — CONTRACT NO. — JOINT DEVT

RELEASE — CHECKER — DESIGN — DRAFTSMAN J. Kelly — PURCHASING — MFG ENGR — PROJECT MGR. — QUALITY ENGR.

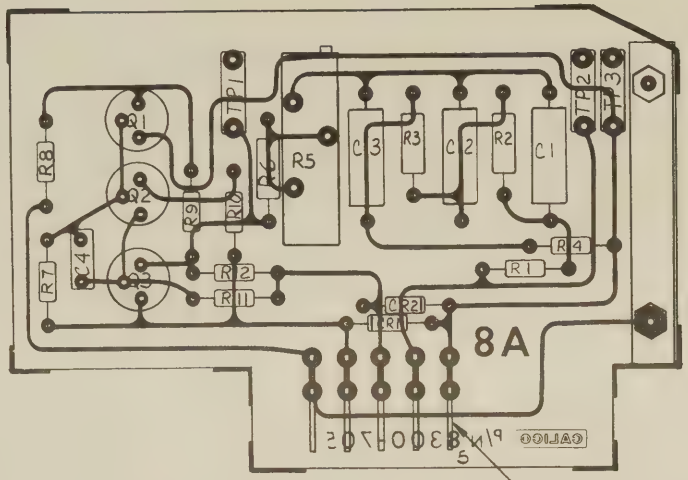
DWG NO. C-8300-071 REV C

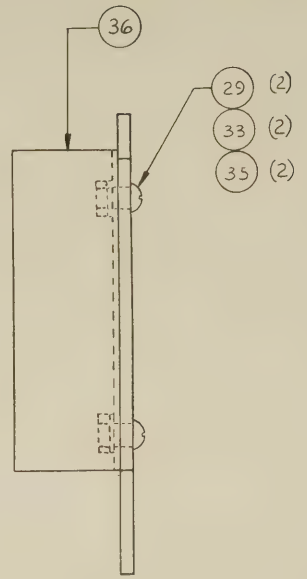
DASH NO. — QTY REQD — NEXT ASSEMBLY — EFF ON — AUTH — SCALE NONE — SHEET 2 OF 3

C-8300-071 C


REVISIONS
REV AUTH DESCRIPTION ZONE EFF ON DATE APRD
SEE SHT 2
TEN THOUSANDS
DS 5 B5750
POLARITY
DS 6 B5856
R37 1.8 K
R40 1.8 K
R34 2K
Q4 2N3440
R35 2K
Q5 2N3440
Q6 2N3440
Q7 2N3440
R38 2K
R39 2K
R33 2K
R36 2K
IC 21 MC 790P
IC 22 MC 789P
C9 .05uF
C8 .001uF
SEE SH 2
+3.6V
GND GND
+3.6 V +3.6 V
DS1-DS5 BASE DIAGRAM BOTTOM VIEW
DS6 SAME DIAGRAM EXCEPT REMOVE PIN 12 AND PINS 13 & 14 ARE 12 & 13 RESP.
NOTES (UNLESS OTHERWISE SPECIFIED)
ITEM NO. PART NUMBER PART NAME MATERIAL — SPECIFICATION CODE IDENT FINISH REF DES ZONE
REQD PER ASSY
DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X° ± 30°
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES
DWG SIZE D
TITLE SCHEMATIC - DECADE & ANALOG DIAGRAM
MODEL 8300
RELEASE
CHECKER
DESIGN
DRFTSMN
PURCHASING
PROJ ENGR
CHF ENGR
CALICO
CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA
CONTRACT NO.
CODE IDENT 16067
DWG NO. D8300-071
REV C
SCALE NONE SHEET 3 OF 3
D8300-071 C

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD





34 (5)

A8

-1 ASSEMBLY

VIEW COMPONENT SIDE

2. MAX. COMPONENT HEIGHT TO BE .50

1. FOR SCHEMATIC SEE DWG. NO. C8300-075.

NOTES: (UNLESS OTHERWISE SPECIFIED)

PL8300-705 PARTS LIST SHEET 4

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
-1								

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓

DWG SIZE C

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DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

TITLE: FILTER BOARD (A8)

PC BOARD ASSEMBLY

MODEL 8300

RELEASE	E. Ehlers	8/7/69	
CHECKER	Wena	2/2/69	PURCHASING
DESIGN			PROJ ENGR
DRFTSMN	T BROWN	1/16/69	CHF ENGR

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.

CODE IDENT 16067

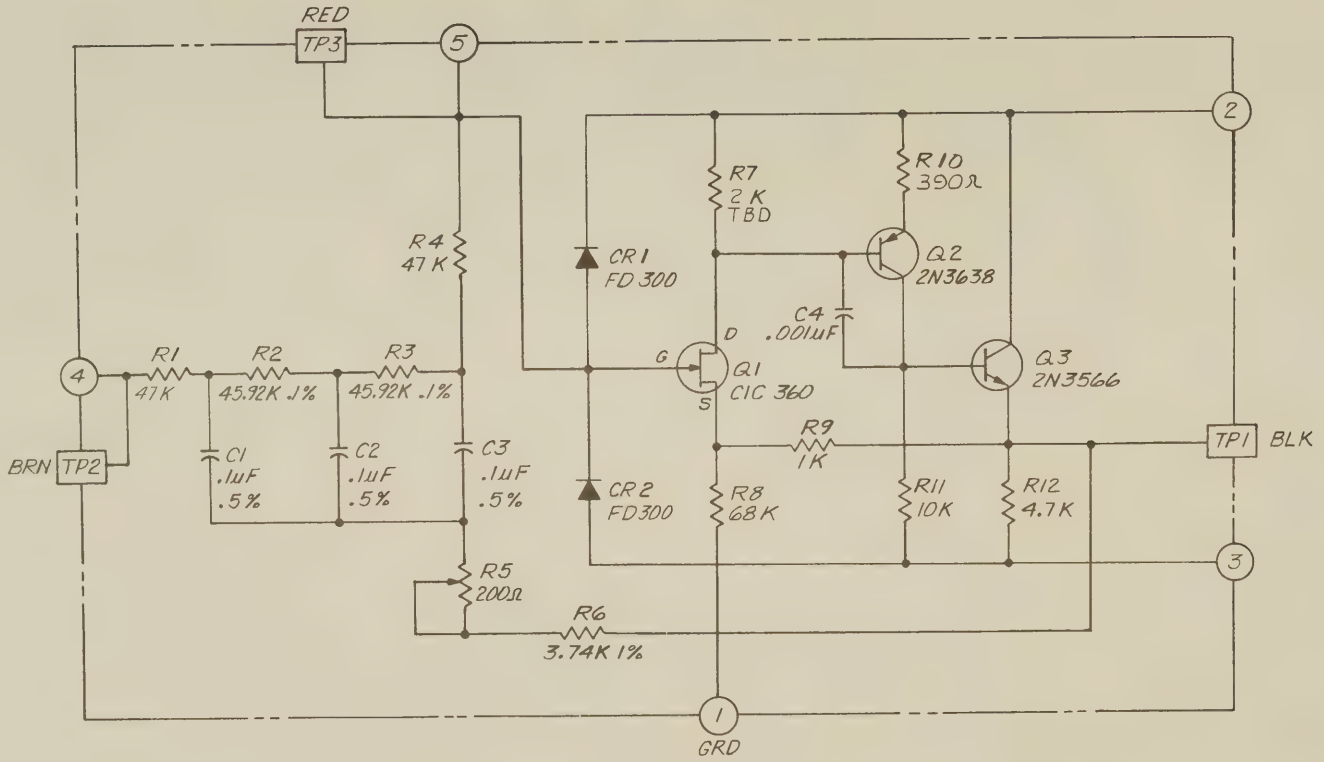
DWG NO. C8300-705 REV /

SCALE 2/1 SHEET 2 OF 4

CALICO F-102

8300-105

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD
A	D.C.	GEN CLEAN UP T Brown 3/10/9			3/10/9	GT



REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

DIM IN INCHES
TOLERANCES
XXX = .010
XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

TITLE
SCHEMATIC - FILTER
(A8)

MODEL	8300		
RELEASE			
CHECKER		1/14/9	PURCHASING
DESIGN			PROJ ENGR GT 1-14-69
DRFTSMN	J. Kelly	9/15/68	CHF ENGR

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.
CODE IDENT 16067
DWG NO. C 8300-075
REV A
SCALE NONE
SHEET 1 OF 1

CALICO F-102

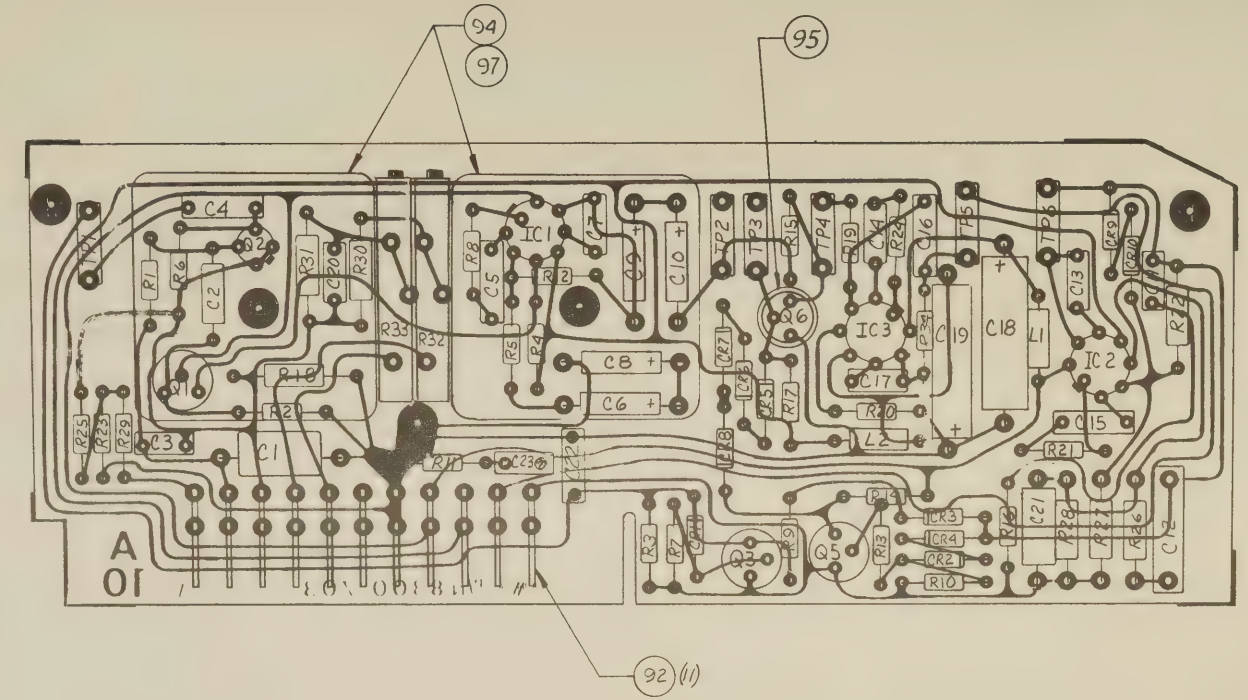
2. FOR P.C. BOARD ASSY. SEE DWG. NO. 8300-705.

1. ALL RESISTORS ARE 1/4W-5%.

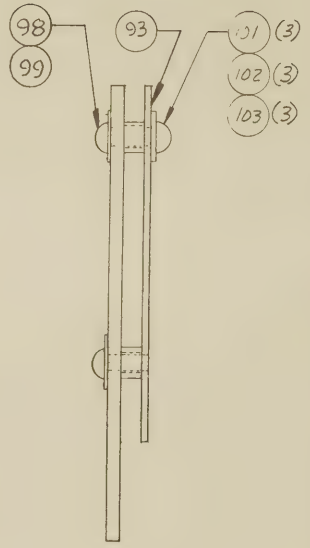
NOTES (UNLESS OTHERWISE SPECIFIED)

8300-075 A

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



A 10
-1 ASSEMBLY
VIEW COMPONENT SIDE



END VIEW

C8300-703 A

2. MAX. COMPONENT HEIGHT TO BE .62
1. FOR SCHEMATIC SEE DWG. NO. D8300-073.

NOTES: (UNLESS OTHERWISE SPECIFIED)

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
/		PL8300-703	PARTS LIST	SHEET 4,5&6				
-1								

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓
DWG SIZE C

TITLE PREAMPLIFER BOARD (A10)
P.C. BOARD ASSEMBLY

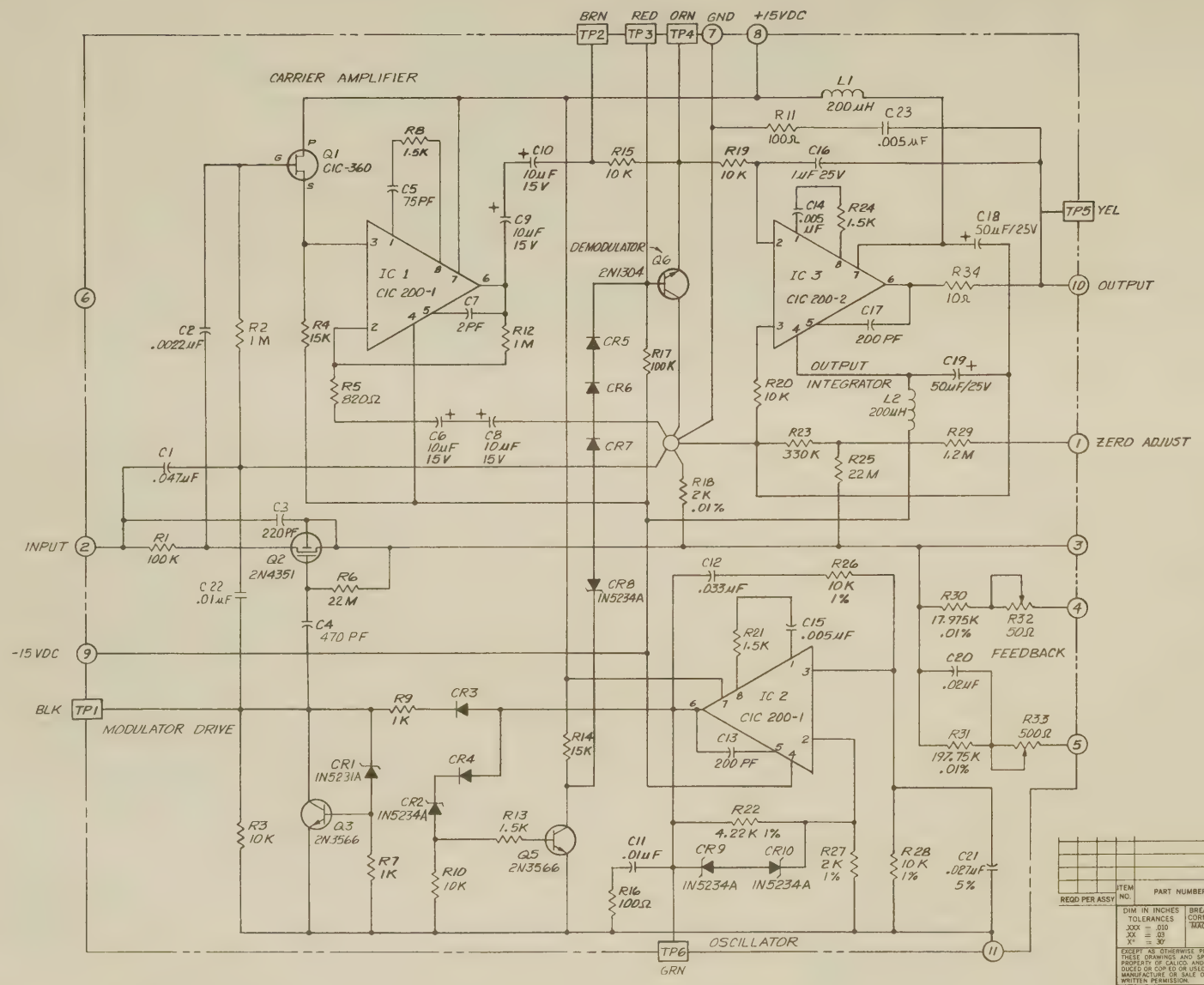
CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

MODEL	8300				CONTRACT NO.	CODE IDENT 16067
RELEASE	C. Smith	2/11/69				
CHECKER	Spencer	2/12/69	PURCHASING		DWG NO. C8300-703	REV A
DESIGN			PROJ ENGR	G.T. 2-12-69		
DRFTSMN	T BROWN	1/17/69	CHF ENGR		SCALE 2/1	SHEET 2 OF 6

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

CALICO F-102



NOTES~

1. ALL RESISTORS ARE 1/4W-5%. UNLESS OTHERWISE SPECIFIED.
2. ALL DIODES ARE IN914 UNLESS OTHERWISE SPECIFIED.
3. FOR P.C. BOARD ASSY. SEE DWG. NO. 8300-703.

NOTES. (UNLESS OTHERWISE SPECIFIED)

REVISIONS

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRO
A	D.C.	GEN CLEAN UP (Brown)			2/11/69	
B	D.C.	R32 500Ω WAS R31			4/7/69	

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
REQD PER ASSY							

DIM. IN INCHES TOLERANCES XXX = .010 XX = .03 X° = 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES
DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

TITLE: SCHEMATIC A10
CHOPPER STABILIZED PREAMPLIFIER

CALICO
CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA

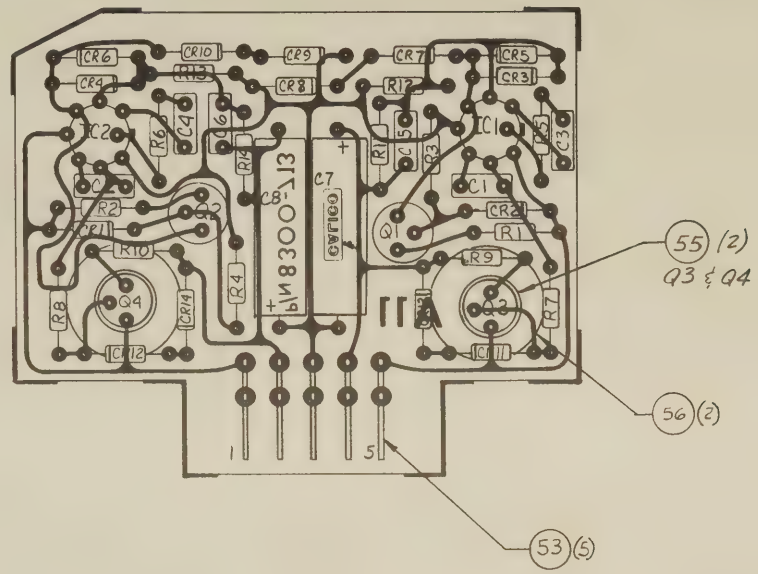
MODEL 8300
CONTRACT NO
CODE IDENT 16067
DWG NO. D8300-073 REV B
SCALE NONE SHEET 1 OF 1

DASH NO.	QTY. REQD	NEXT ASSEMBLY	EFF ON	AUTH

RELEASE
CHECKER J. Wiens 1/4/69 PURCHASING
DESIGN PROJ ENGR GJ 1/7/69
DFTSMN J. Kell 1/7/69 CHF ENGR

D8300-073 B

REVISIONS					
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



A 11
-1 ASSEMBLY
VIEW COMPONENT SIDE

2. MAX. COMPONENT HEIGHT TO BE .45

1. FOR SCHEMATIC SEE DWG. NO. D8300-083.

NOTES: (UNLESS OTHERWISE SPECIFIED)

D8300-713 /

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
/		PL8300-713	PARTS LIST	SHEET 4				
-1								

DIM IN INCHES
TOLERANCES
.XXX = .010
.XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

TITLE: POWER SUPPLY #3 (A11)
P.C. BOARD ASSEMBLY

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

MODEL

CONTRACT NO. | CODE IDENT 16067

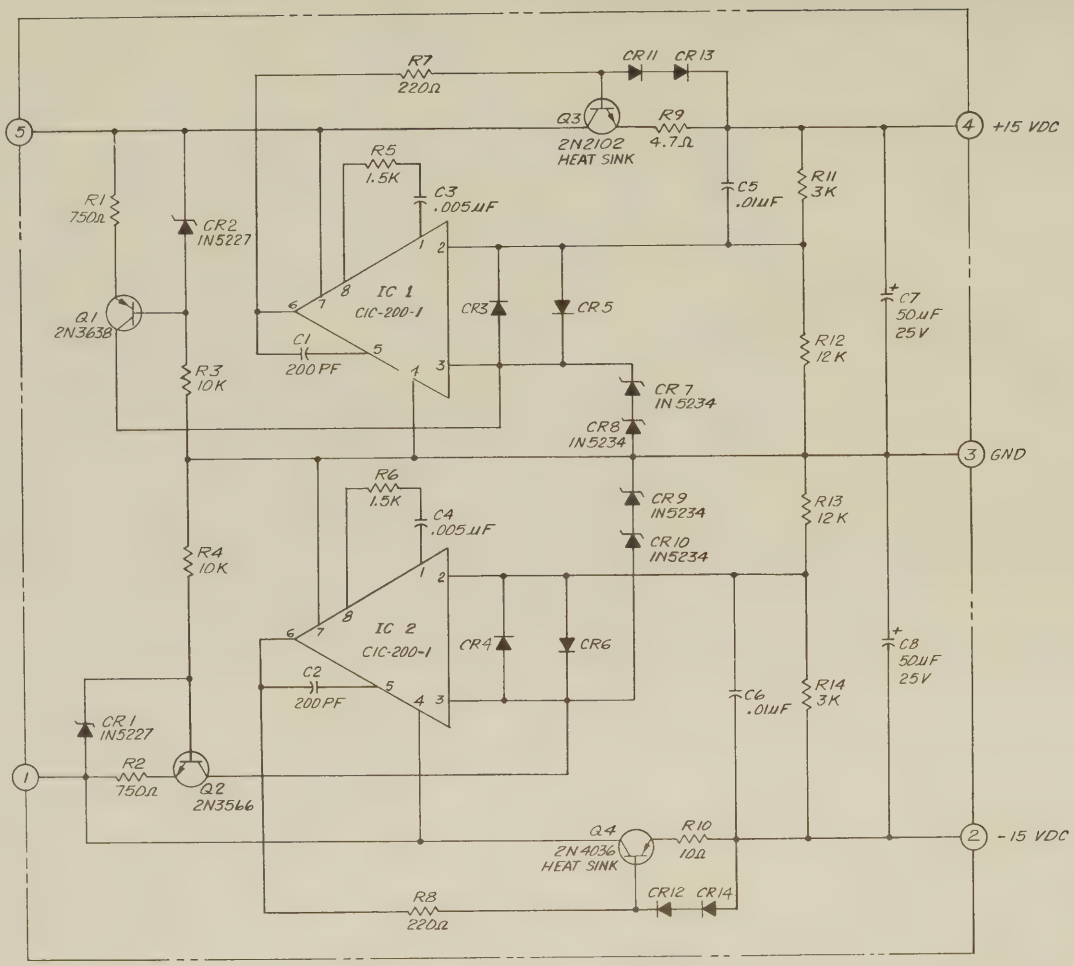
RELEASE	E. Shultz	2/17/69			
CHECKER	[signature]	2/12/69	PURCHASING		
DESIGN			PROJ ENGR	[signature]	2/17/69
DRFTSMN	T BROWN	1/16/69	CHF ENGR		

DWG NO. C8300-713 | REV /

SCALE 2/1 | SHEET 2 OF 5

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

CALICO F-102



3. FOR P.C. BOARD ASSY SEE DWG. NO. 8300-713.
2. ALL DIODES ARE IN914.
1. ALL RESISTORS ARE 1/4 W-5%.

NOTES. (UNLESS OTHERWISE SPECIFIED)

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD
A	D.C.	GEN CLEAN UP			3/1/9	

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE	REQD PER ASSY

DIM IN INCHES TOLERANCES XXX ± .010, XX ± .03, X ± 30'. BREAK ALL SHARP CORNERS & EDGES MACH SURFACES. DWG SIZE D.

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

TITLE: SCHEMATIC - POWER SUPPLY NO. 3 (All)

CALICO — CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA

MODEL 8300 | CONTRACT NO | CODE IDENT 16067

RELEASE | CHECKER | DESIGN | DRFTSMN J. Keller 12/4/68 | PURCHASING | PROJ ENGR GT 1-14-69 | CHF ENGR

DWG NO D8300-083 | REV /

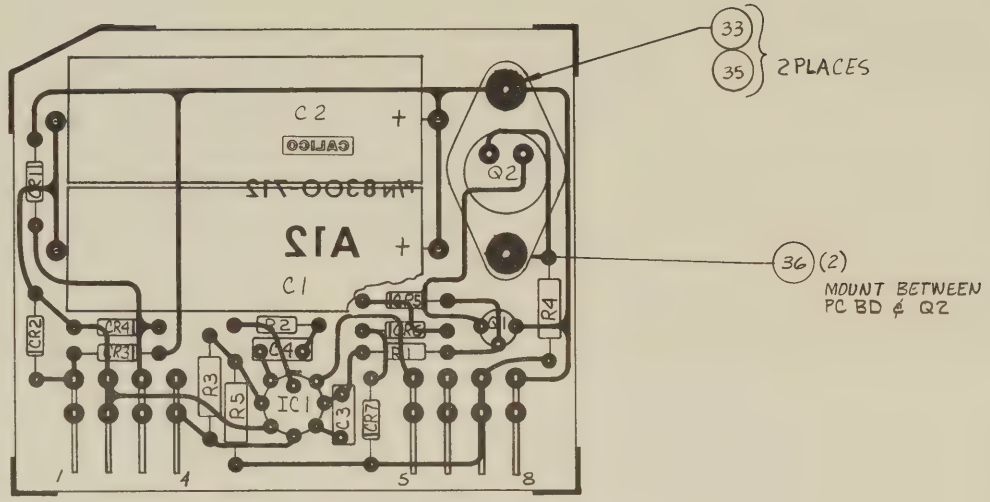
SCALE NONE | SHEET 1 OF 1

DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

CALICO F-203

D8300-083 /

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



A12
-1 ASSEMBLY
VIEW COMPONENT SIDE

2. MAX. COMPONENT HEIGHT TO BE .80

1. FOR SCHEMATIC SEE DWG. NO. C8300-082

NOTES: (UNLESS OTHERWISE SPECIFIED)

C8300-712 A

PL8300-712 PARTS LIST SHEET 4

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
-1								

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X° ± 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓
DWG SIZE C

TITLE POWER SUPPLY #2 (A12)
P.C. BOARD ASSEMBLY

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

MODEL 8300
CONTRACT NO.
CODE IDENT 16067

RELEASE	E Shultz	7/17/69		
CHECKER	Jwerner	2/12/69	PURCHASING	
DESIGN			PROJ ENGR	G.T. 7/12/69
DRFTSMN	T BROWN	1/16/69	CHF ENGR	

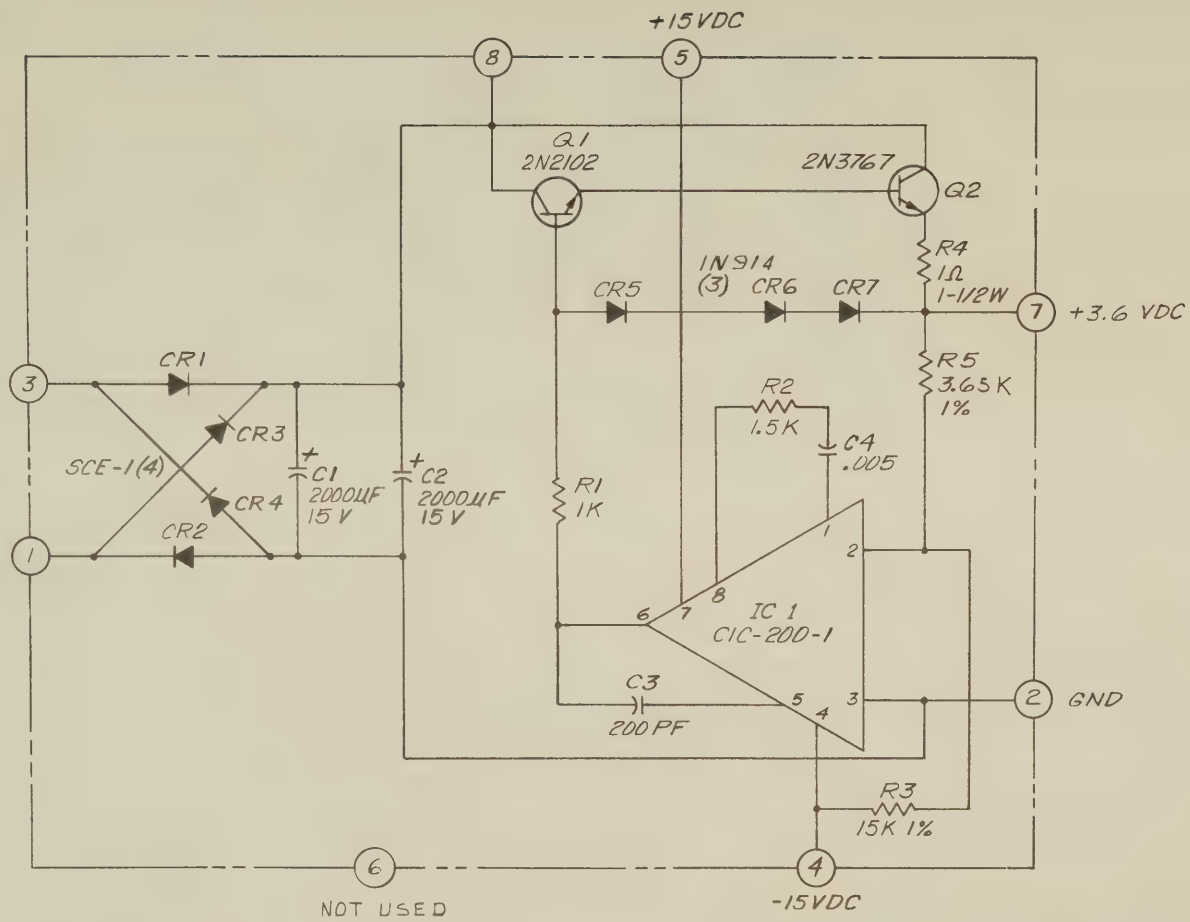
DWG NO. C8300-712 REV A
SCALE 2/1 SHEET 2 OF 4

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

CALICO F-102

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD
A	D.C.	GEN CLEAN UP T BROWN 3/10/9			3/11/9	



REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES
TOLERANCES
.XXX = .010
.XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

TITLE
SCHEMATIC
POWER SUPPLY NO. 2 (A12)

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

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MODEL	8300				CONTRACT NO.	CODE IDENT 16067
RELEASE	E. Tiel	11/				
CHECKER	J. Jones	11/4/64	PURCHASING			
DESIGN			PROJ ENGR	GT 1-19-64	DWG NO. C8300-082	REV /
DRFTSMN	J. Kelly	12/11/68	CHF ENGR		SCALE NONE	SHEET 1 OF 1

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

2. FOR P.C. BOARD ASSY. SEE DWG. NO. 8300-712.

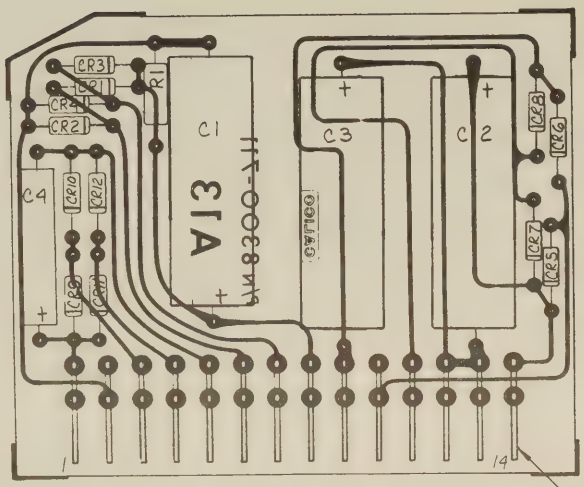
1. ALL RESISTORS ARE 1/4W-5%.

NOTES: (UNLESS OTHERWISE SPECIFIED)

C8300-082 /

CALICO F-102

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



28 (14)

A13
-1 ASSEMBLY
VIEW COMPONENT SIDE

C8300-711

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
-1		PL 8300-711	PARTS LIST	SHEET 4				

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓
DWG SIZE C

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TITLE POWER SUPPLY #1 P.C. BOARD ASSEMBLY (A13)

MODEL 8300

RELEASE	E. Sweet	3/7/69			
CHECKER	Werner	3/12/69	PURCHASING		
DESIGN			PROJ ENGR	J.K.	3/17/69
DRFTSMN	T BROWN	11/5/69	CHF ENGR		

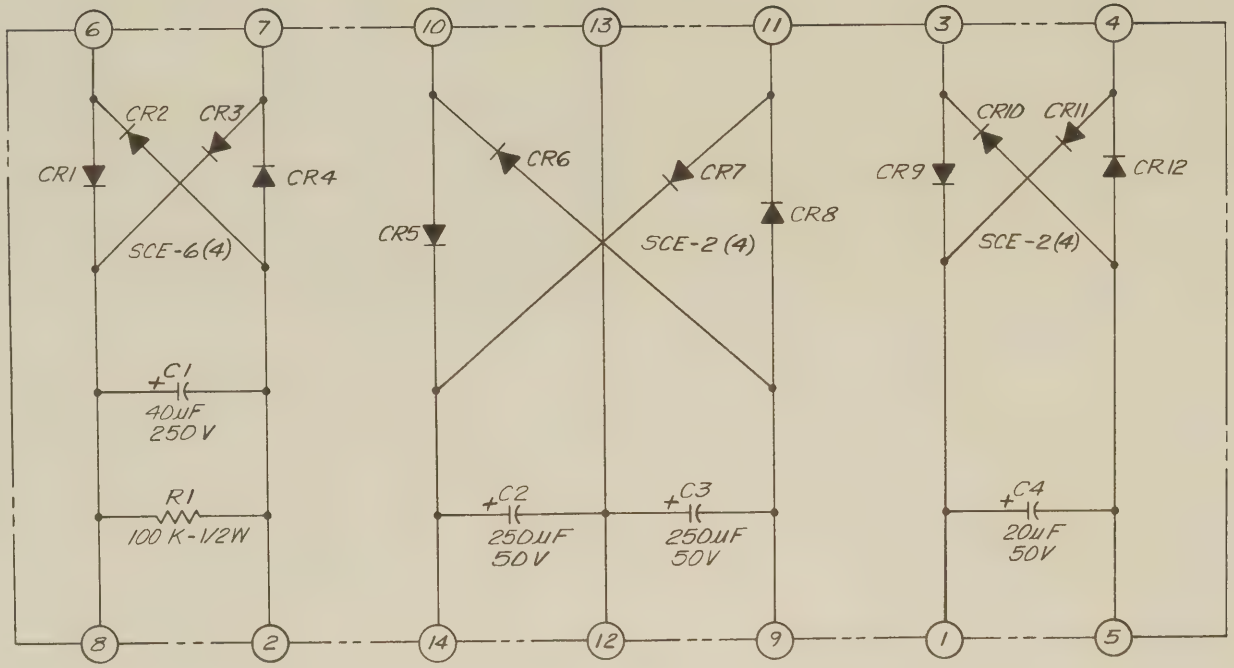
CALICO
CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

CONTRACT NO.
CODE IDENT 16067
DWG NO. C8300-711
REV /
SCALE 2/1
SHEET 2 OF 4

2. MAX. COMPONENT HEIGHT TO BE .80
1. FOR SCHEMATIC SEE DWG NO. C8300-081

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
REQD PER ASSY							

DIM IN INCHES
TOLERANCES
.XXX = .010
.XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

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TITLE
SCHEMATIC
POWER SUPPLY NO. 1 (A13)

MODEL 8300
RELEASE E Shuler 1/14/69
CHECKER [signature] 1/14/69 PURCHASING
DESIGN PROJ ENGR GT 1-14-69
DRFTSMN J. Kelly 1/14/69 CHF ENGR

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.
CODE IDENT 16067
DWG NO. C8300-081 REV 1
SCALE NONE SHEET 1 OF 1

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

CALICO F-102

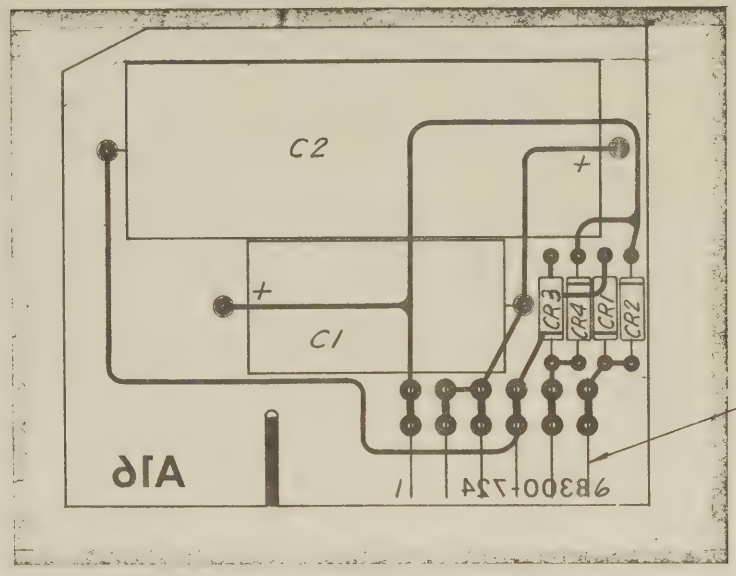
2. FOR P.C. BOARD ASSY. SEE DWG. NO. 8300-711.

1. ALL RESISTORS ARE 1/4W-5%.

NOTES: (UNLESS OTHERWISE SPECIFIED)

C8300-081 1

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



A16
-1 ASSEMBLY
VIEW COMPONENT SIDE

2. MAX. COMPONENT HEIGHT TO BE 1.06

1. FOR SCHEMATIC SEE DWG. No. 8300-087.

NOTES: (UNLESS OTHERWISE SPECIFIED)

PL8300-724 PARTS LIST SHEET 4

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
-1								

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'
BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓
DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH
-1	1	8300-404-1		

TITLE: POWER SUPPLY (A16) P.C. BOARD ASSEMBLY

MODEL 8303

RELEASE	E. Ehrlich	11/5	PURCHASING
CHECKER	W. Bordie	11/5	PROJ ENGR
DESIGN			CHF ENGR
DRFTSMN	Wiener	4/11/69	

CALICO
CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

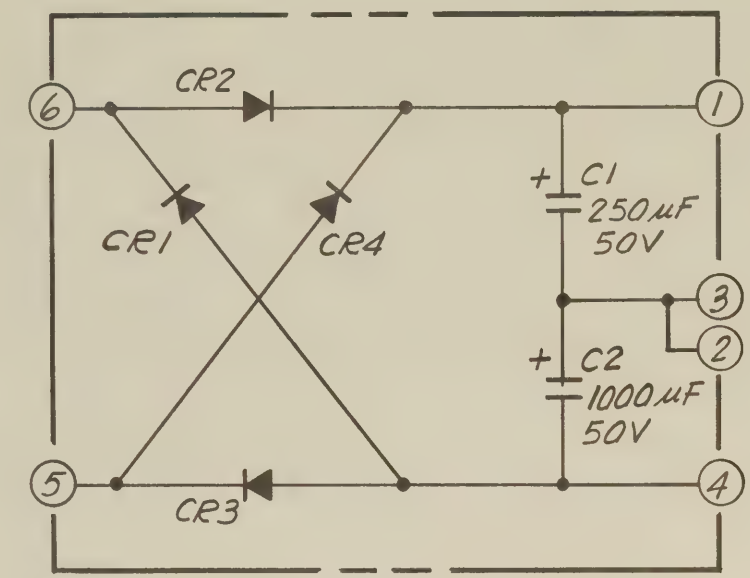
CONTRACT NO.
CODE IDENT 16067
DWG NO. C8300-724 REV
SCALE 2/1 SHEET 2 OF 4

C8300-724

CALICO F-102

L80-00888

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

2. FOR P.C. BOARD ASSY SEE DWG. 8300-724

1. DIODES ARE SCE-1

NOTES: (UNLESS OTHERWISE SPECIFIED)

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

DIM IN INCHES
TOLERANCES
.XXX = .010
.XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE B

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO, AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

TITLE
SCHEMATIC A16
POWER SUPPLY BD.

MODEL 8303

RELEASE	E. Smith	7/15/69			
CHECKER	[illegible]	7/15/69	PURCHASING		
DESIGN			PROJ ENGR	G. THRAN	7/15/69
DRFTSMN	[illegible]	3/18/69	CHF ENGR		

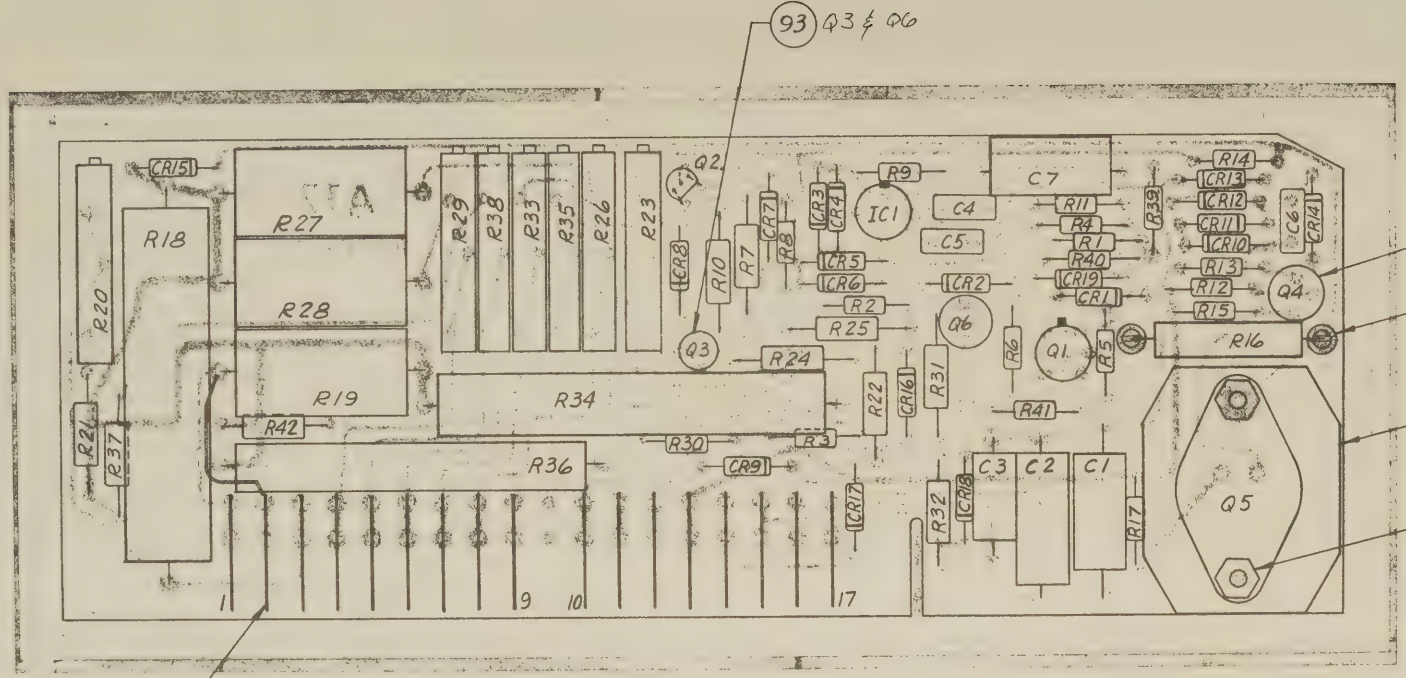
CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.
CODE IDENT 16067

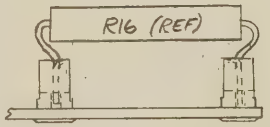
DWG NO. B8300-087 REV \

SCALE — SHEET 1 OF 1

CALICO F-101



A17
-1 ASSEMBLY
VIEW COMPONENT SIDE



DETAIL "A"

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
-1		PL8300-723	PARTS LIST	SHEETS 4, 5 & 6				

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH
-1	1	8300-404		

TITLE: CONSTANT CURRENT SOURCE P.C. BOARD ASSY (A17)

MODEL	8303		
RELEASE	[illegible]	7/5/67	
CHECKER	[illegible]	7/7	PURCHASING
DESIGN	[illegible]		PROJ ENGR
DRFTSMN	[illegible]	4/18/67	CHF ENGR

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.

CODE IDENT 16067

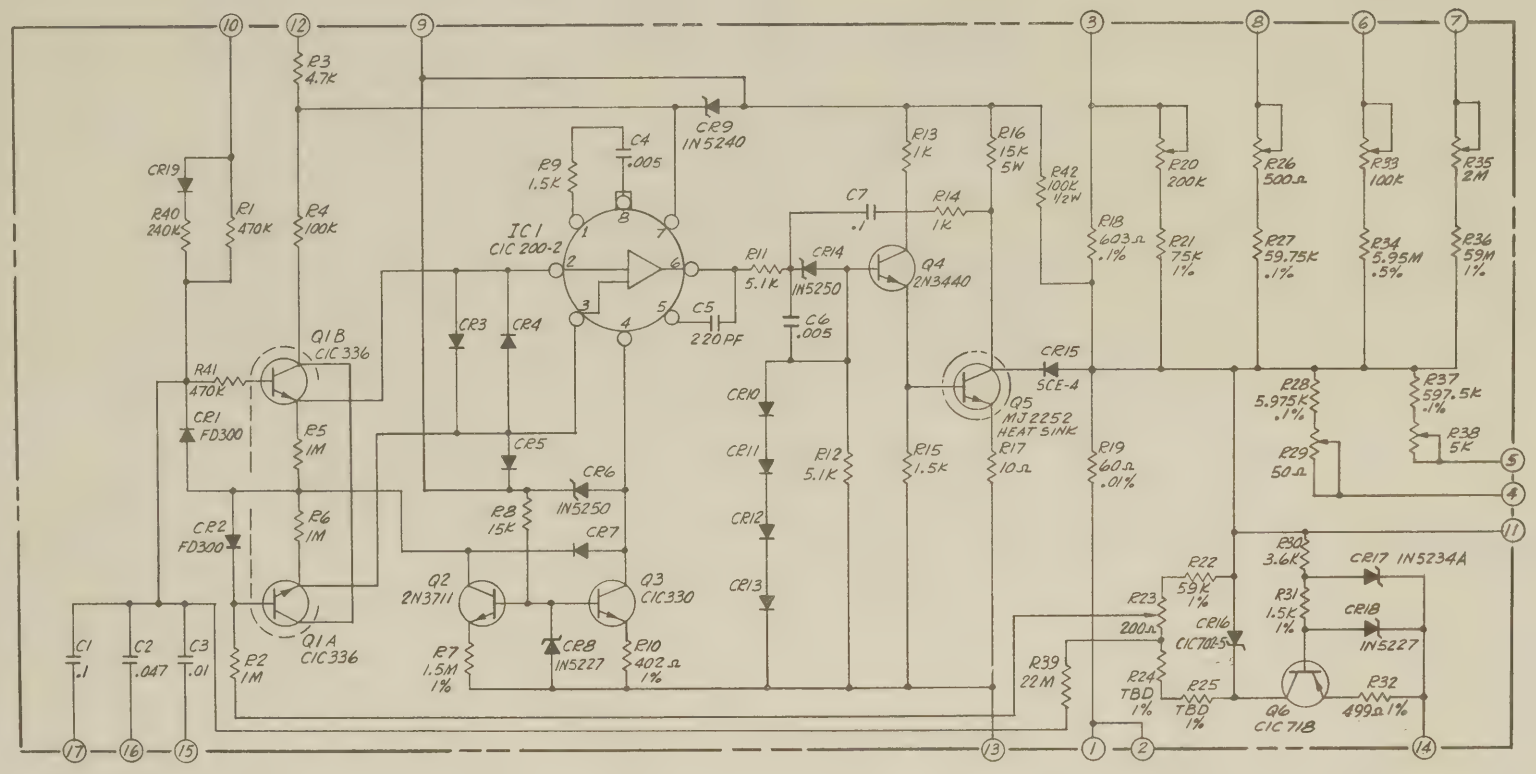
DWG NO. C8300-723 REV A

SCALE 2/1 SHEET 2 OF 6

1. FOR SCHEMATIC SEE DWG. No. 8300-086

NOTES: (UNLESS OTHERWISE SPECIFIED)

C8300-723 A



4. FOR P.C. BOARD ASSY SEE DWG. 8300-723
3. UNMARKED DIODES ARE IN914
2. CAPACITANCE IN μF.
1. RESISTORS 1/4 W 5%

NOTES (UNLESS OTHERWISE SPECIFIED)

REVISIONS

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRO

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES TOLERANCES XXX = .010 XX = .03 X° = 30' | BREAK ALL SHARP CORNERS & EDGES MACH SURFACES | DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

TITLE: SCHEMATIC (A17) CONSTANT CURRENT SOURCE

MODEL 8303

RELEASE	E. Smith	7/15/69
CHECKER		
DESIGN		
DRFTSMN		3/18/69
PURCHASING		
PROJ ENGR	G. THROP	7/15/69
CHF ENGR		

CALICO — CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA

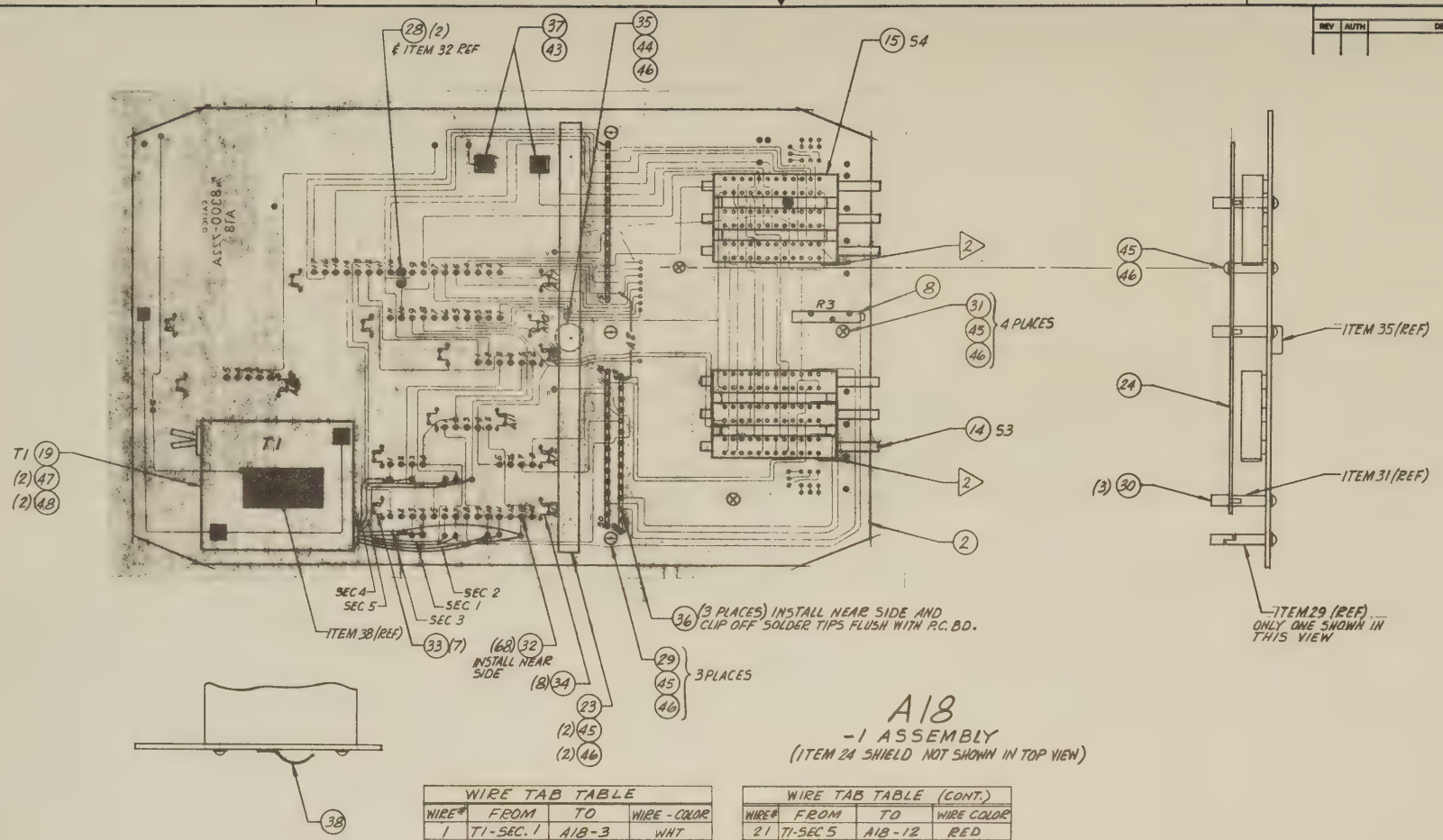
CONTRACT NO. | CODE IDENT 16067

DWG NO. D8300-086 | REV

SCALE — | SHEET 1 OF 1

DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

D8300-086



A18
-1 ASSEMBLY
(ITEM 24 SHIELD NOT SHOWN IN TOP VIEW)

WIRE TAB TABLE			
WIRE#	FROM	TO	WIRE - COLOR
1	T1-SEC. 1	A18-3	WHT
2	T1-SEC. 1	A18-4	BLK
3	T1-SEC. 2	A18-5	RED
4	T1-SEC. 2	A18-6	BLK
5	T1-SEC. 2	A18-7	WHT
6	T1-SEC. 3	A18-1	BLK
7	T1-SEC. 3	A18-2	WHT
8	T1-SEC. 3 INNER SHIELD	A18-7	#22 SLEEVED BUSS
9	T1-SEC. 3 OUTER SHIELD	3" PIG TAIL	#22 SLEEVED BUSS
10	T1-SEC. 4	A18-8	BLK
11	T1-SEC. 4	A18-9	WHT
12	A18-13	OTHER END NOT CONNECTED	#22 SLEEVED BUSS 4" LG.
13	A18-14	"	4" LG.
14	A18-15	"	4" LG.
15	A18-16	"	8" LG.
16	A18-17	"	8" LG.
17	A18-18	"	2" LG.
18	A18-19	"	4" LG.
19	A18-20	"	2" LG.
20	A18-33	"	4" LG.

WIRE TAB TABLE (CONT.)			
WIRE#	FROM	TO	WIRE COLOR
21	T1-SEC 5	A18-12	RED
22	T1-SEC 5	A18-10	WHT
23	T1-SEC 5	A18-11	BLK

2 MOUNT PUSH BUTTON SWITCHES 1/16 OFF BOARD, WITH LATCHING SPRING FACING UP.

1. FOR SCHEMATIC SEE DWG. NO. B300-085

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APPD

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
-/ REQD PER ASSY	B8300-722	PARTS LIST	SHEET 1 of 5				

DIM IN INCHES TOLERANCES: XXX = .250, XX = .03, X = .5°. BREAK ALL SHARP CORNERS & EDGES. MACH SURFACES ✓. DWG SIZE D.

TITLE: MOTHER BOARD (A18) P.C. BOARD ASSEMBLY

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

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MODEL 8303 | RELEASE | CHECKER | DESIGN | DRAFTSMAN | PROJ ENGR | CHF ENGR | PURCHASING

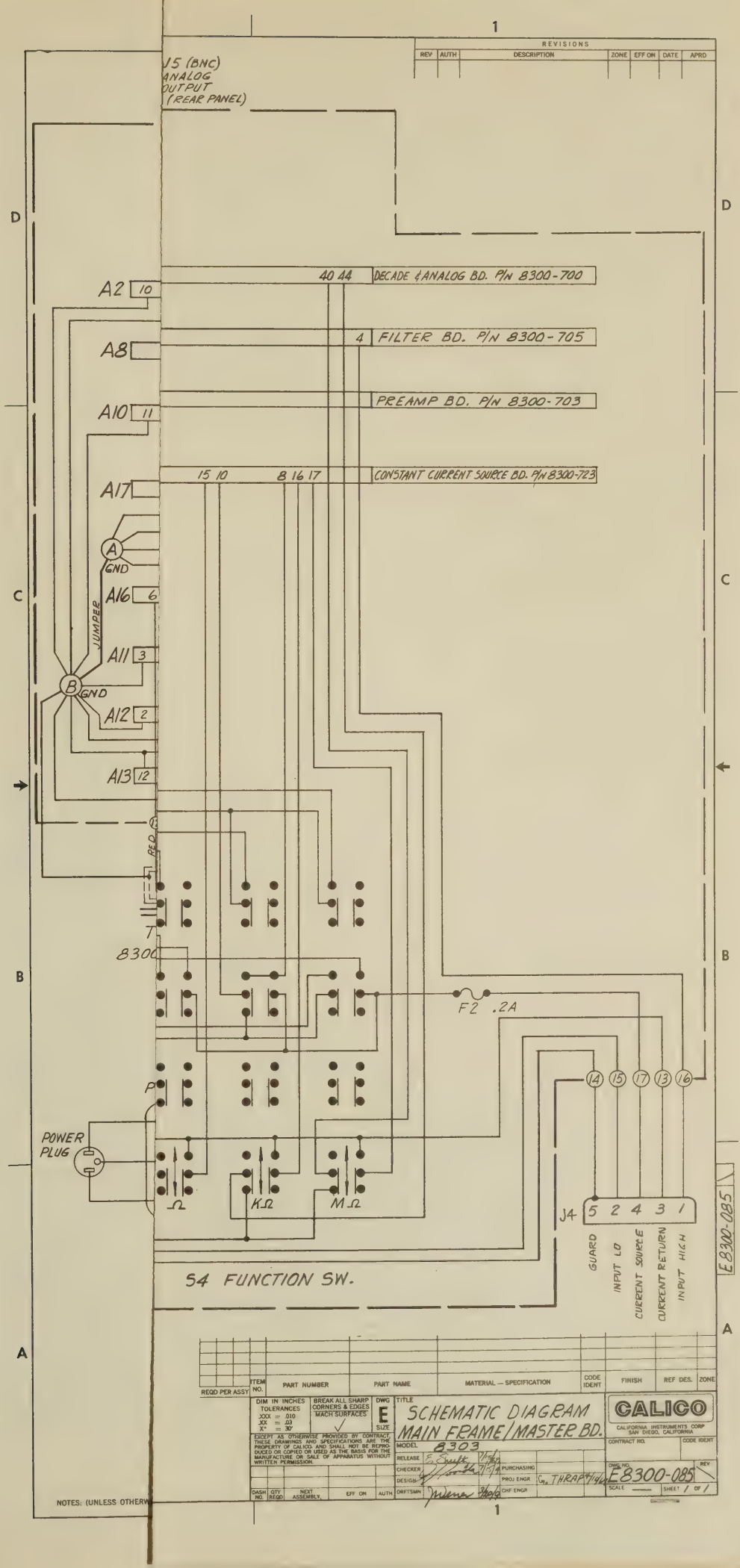
CONTRACT NO. | ORDER NUMBER 16067

-1 | 1 | B300-404 | NEXT ASSEMBLY | EFF ON | AUTH

DWG NO. B8300-722 REV

SCALE 1/1 SHEET 2 OF 5

B8300-722


REVISIONS
REV | AUTH | DESCRIPTION | ZONE | EFF ON | DATE | APRD
J5 (BNC) ANALOG OUTPUT (REAR PANEL)
40 44 DECADE & ANALOG BD. P/N 8300-700
4 FILTER BD. P/N 8300-705
PREAMP BD. P/N 8300-703
15 10 8 16 17 CONSTANT CURRENT SOURCE BD. P/N 8300-723
A2 10
A8
A10 11
A17
A16 6
A11 3
A12 2
A13 12
A GND
B GND
JUMPER
RED
T
8300
P
POWER PLUG
Ω
KΩ
MΩ
F2 .2A
54 FUNCTION SW.
J4 5 2 4 3 1
GUARD
INPUT LO
CURRENT SOURCE
CURRENT RETURN
INPUT HIGH
14 15 17 13 16
E8300-085
ITEM NO. | PART NUMBER | PART NAME | MATERIAL — SPECIFICATION | CODE IDENT | FINISH | REF DES. | ZONE
REQD PER ASSY
DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES
DWG SIZE E
TITLE SCHEMATIC DIAGRAM MAIN FRAME/MASTER BD.
MODEL 8303
RELEASE E. Smith 7/7/71
CHECKER
DESIGN
PROJ ENGR
PURCHASING
CHF ENGR
DRFTSMN
CALICO
CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA
CONTRACT NO. CODE IDENT
DWG NO. E8300-085 REV
SCALE SHEET 1 OF 1
DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH
NOTES: (UNLESS OTHERW

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	ECT OR	DATE	APRD

J5 (BNC) ANALOG OUTPUT (REAR PANEL)

A GND

33

A2 10 42 9 1 2 16 22 23 4 18 7 41 6 5 39 30 26 19 8 20 27 36 13 31 37 14 32 24 25 21 35 29 11 43 38 45 33 28 17 34 3 15 12 40 44 — DECADE & ANALOG BD. P/N 8300-700

A8 1 3 2 5 4 — FILTER BD. P/N 8300-705

R3 50 K (FRONT PANEL)

A10 11 7 9 1 8 2 6 5 4 3 10 — PREAMP BD. P/N 8300-703

A17 12 13 9 11 14 5 6 7 2 1 3 4 15 10 8 16 17 — CONSTANT CURRENT SOURCE BD. P/N 8300-723

A GND

A16 6 3 5 1 4 6 2 — POWER SUPPLY P/N 8300-724

JUMPER

A11 3 2 1 5 4 — POWER SUPPLY #3 P/N 8300-713

B GND

A12 2 1 3 8 7 4 5 — POWER SUPPLY #2 P/N 8300-712

A13 12 13 2 3 4 6 7 10 11 5 1 9 14 8 — POWER SUPPLY #1 P/N 8300-711

12 RED, 10 WHT, 11 BLK, BLK, WHT, BLK, WHT, WHT, BLK, RED, WHT, BLK

SEC. 5 | SEC. 4 | SEC. 3 | SEC. 1 | SEC. 2

T1 (PART OF A1B ASSY) 8300-016

PRI. 1 | PRI. 2

WHT BLK WHT BLK

230

115

S1

P3 J3

POWER PLUG

L1 2.5MH

C1 .01 μF

R1 1Ω 3W 1%

CHAS. GND E1

C2 .01 μF

L2 2.5MH

F1 .2A S.B.

WHT BLK RED

S2

R2 180K

E2 19 GUARD BOX

A1B MOTHER BOARD P/N 8300-722

S3 RANGE SW. 1 10 100

S4 FUNCTION SW. Ω KΩ MΩ

F2 .2A

J4 5 2 4 3 1 — GUARD, INPUT LO, CURRENT SOURCE, CURRENT RETURN, INPUT HIGH

14 15 17 13 16

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF. DES.	ZONE
REQD PER ASSY							

DIM IN INCHES TOLERANCES XXX = .010, XX = .02, X = .05. BREAK ALL SHARP CORNERS & EDGES. MACH SURFACES. DWG SIZE E.

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS ARE SPECIFICATIONS, AND THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

TITLE: SCHEMATIC DIAGRAM MAIN FRAME/MASTER BD.

MODEL 8303

RELEASE E. Smith 7/74

CHECKED 7/74 PURCHASING

DES/ENG 7/74 PROJ ENGR G. THRAPP 7/74

DRFT'SMN 7/74 CHF. ENGR

CALICO

CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

CONTRACT NO. CODE IDENT

DWG NO. E8300-085 REV

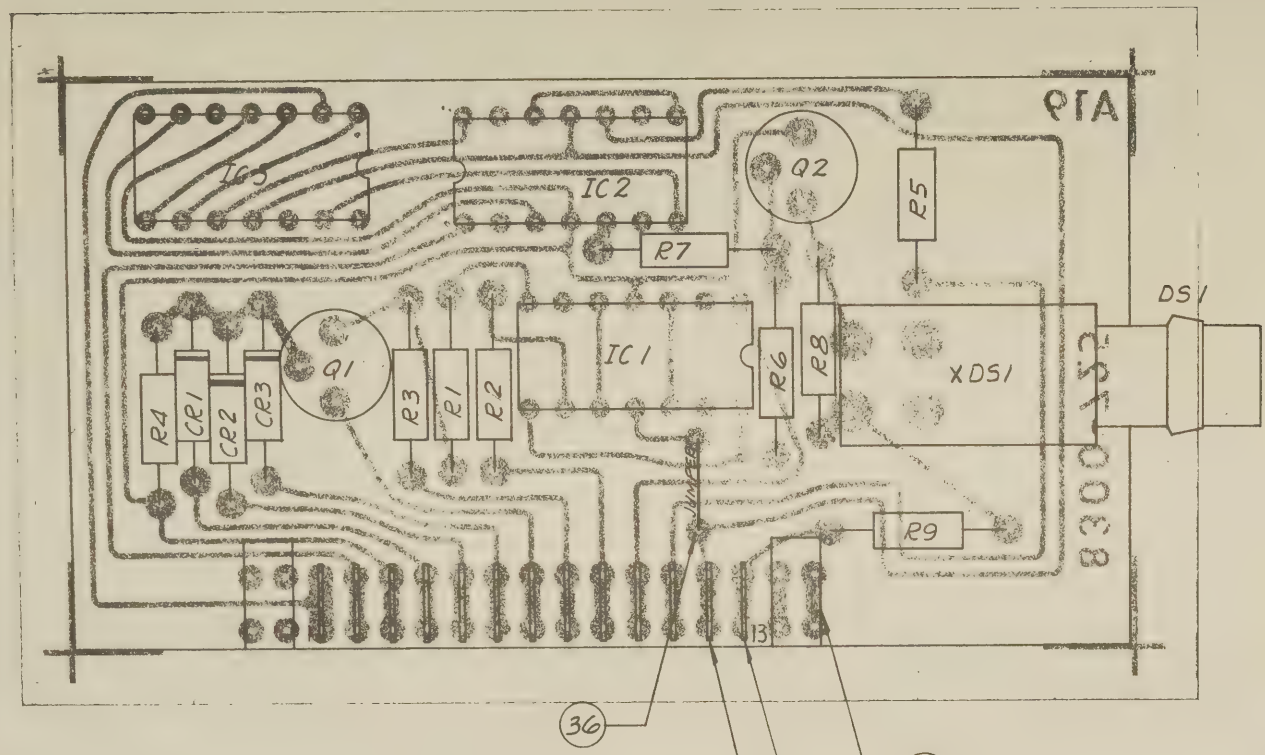
SCALE — SHEET 1 OF 1

CALICO P 6M

E8300-085

DASH NO.	QTY. REQD	NEXT ASSEMBLY	EFF ON	AUTH

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



A19
-1 ASSEMBLY
VIEW COMPONENT SIDE

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES
TOLERANCES
.XXX = .010
.XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

TITLE
OVERLOAD A19
P.C. BOARD ASSEMBLY

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO. AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

MODEL 8300 & 8303
CONTRACT NO.
CODE IDENT 16067

RELEASE	E. Smith	6/11/69	
CHECKER	Alfonda	6/11/69	PURCHASING
DESIGN			PROJ ENGR
DRFTSMN	Jwemer	6/11/69	CHF ENGR

DWG NO. C8300-725 REV \
SCALE 4/1 SHEET 2 OF 4

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

1. FOR SCHEMATIC SEE DWG. NO. C8300-088

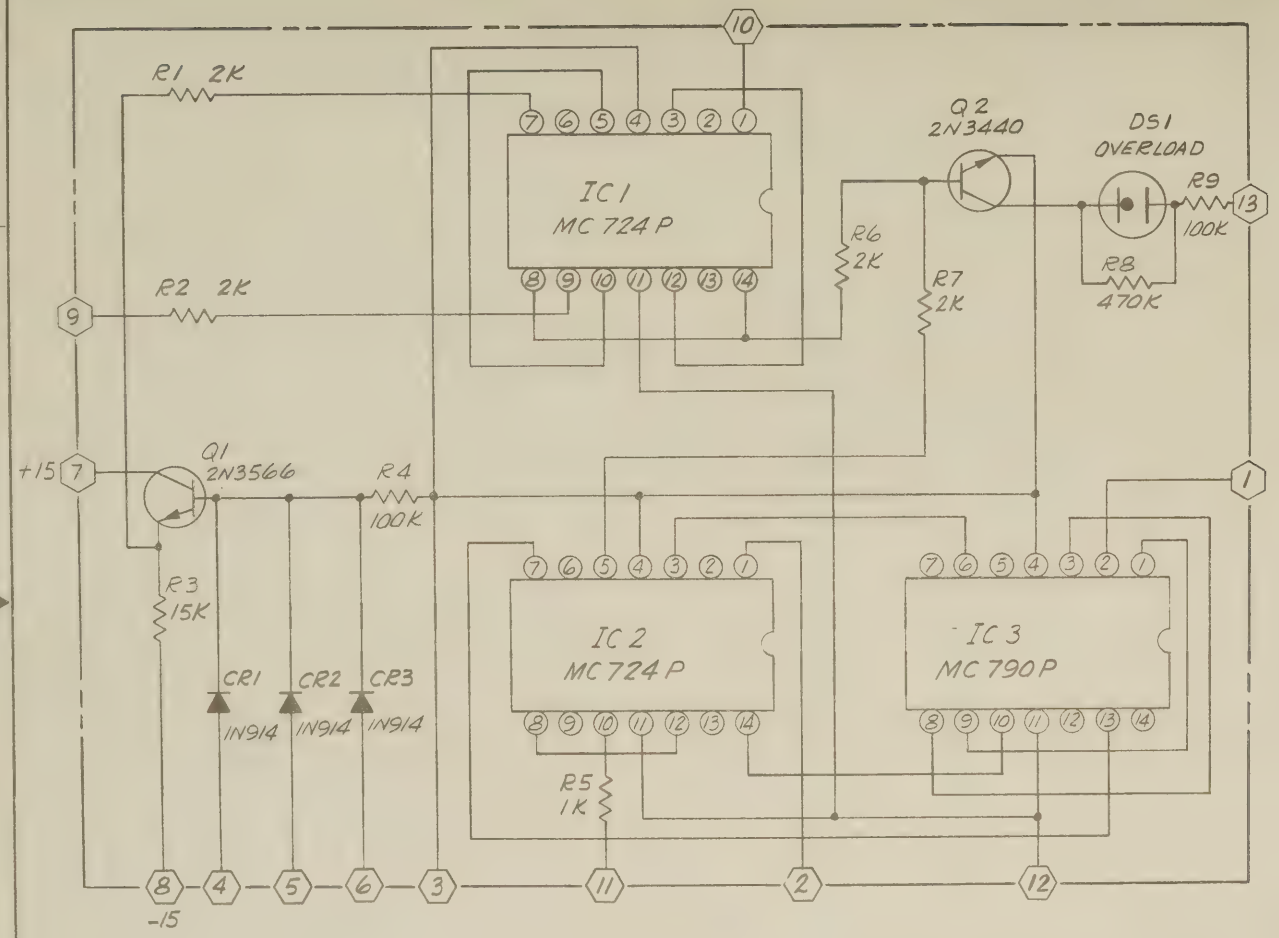
NOTES: (UNLESS OTHERWISE SPECIFIED)

C8300-725 \

CALICO F-102

A19

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



2. FOR P.C. BOARD ASSY SEE DWG. No. 8300-725

1. ALL RESISTORS ARE 1/4 W 5%

NOTES: (UNLESS OTHERWISE SPECIFIED)

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓

DWG SIZE C

TITLE: SCHEMATIC - OVERLOAD (A19)

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATION, ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

MODEL 8300 & 8302

RELEASE

CHECKER

DESIGN

DRFTSMN

PURCHASING

PROJ. ENGR.

CHF. ENGR.

CONTRACT NO.

CODE IDENT 16067

DWG NO. C8300-088 REV /

SCALE —— SHEET / OF /

DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

C8300-088

4 3 2 1

REPLACEABLE PARTS

7.1 GENERAL

This section contains ordering information and complete list of replaceable parts. (Applicable part lists to the appendix section are contained therein, not in this section.) Parts are listed by major assembly in alphanumeric order of their reference designators. Description, manufacturers' part number, manufacturers' code ident number (see Appendix A for list of manufacturers), and CALICO's stock number are indicated.

7.2 ORDERING INFORMATION

In order to provide our customers with prompt service on replacement parts, please provide the following information, when applicable, for each part ordered.

a) Model number and serial number of the instrument

b) CALICO part number of the sub-assembly where component is located

c) Component reference designator

d) Component description

e) Component manufacturer number and code ident

f) CALICO stock number

All replacement parts orders should be placed with CALIFORNIA INSTRUMENTS CORPORATION, San Diego, California.

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | **PARTS LIST**

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	8300-404	DIGITAL OHMMETER	16067		1
	8300-405-1	MODEL 8303 Accessory Kit	16067	1-42071	2
	8300-402-2	RACK MTG. ASSY	16067		3
	8300-401-2	BEZEL ASSY (8303)	16067		4
					5
					6
					7
	8300-202-1	SIDE PANEL	16067	1-42030	8
	8300-202-2	SIDE PANEL	16067	1-42031	9
	8300-203-7	FRONT SUB PANEL	16067	1-42036	10
	8300-205-7	REAR PANEL	16067	1-42035	11
	8300-206-7	TOP COVER	16067	1-42033	12
	8300-206-8	BOTTOM COVER	16067	1-42034	13
	8300-208-7	SHIELD TRANSFORMER	16067	1-42037	14
	8300-215-7	BUTCH PLATE	16067	1-42040	15
	8300-231-7	POLARIZER	16067	1-42065	16
	8300-236-7	BUTCH PLATE	16067	1-42070	17
					18
					19
					20
	8300-715-7	GUARD SHIELD COVER BOT.	16067	1-55049	21
	8300-716-7	GUARD SHIELD R.S.	16067	1-55050	22
	8300-717-7	GUARD SHIELD L.S.	16067	1-55051	23
	8300-718-7	GUARD SHIELD COVER TOP	16067	1-55052	24
	8300-719-7	GUARD SHIELD XFORMER	16067	1-55053	25
	8300-720-7	GUARD SHIELD XFROMER	16067	1-55054	26
					27
					28
					29
A1		NOT USED			30
A2	8300-700-1	DECADE and ANALOG BD.	16067		31
A3 THRU A7		NOT USED			32
A8	8300-705-1	FILTER BOARD	16067		33
A9		NOT USED			34
A10	8300-703-1	PRE-AMP BOARD	16067		35
A11	8300-713-1	POWER SUPPLY #3	16067		36

MODEL 8303 | CALICO P/N 8300-404 | ASSY R.O.

TITLE DIGITAL OHMMETER | SHT 3 OF 5

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | **PARTS LIST**

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A12	8300-712-1	POWER SUPPLY #2	16067		37
A13	8300-711-1	POWER SUPPLY #1	16067		38
A14		NOT USED			39
A15	8300-710-1	PRINT BOARD	16067		40
A16	8300-724-1	POWER SUPPLY BOARD	16067		41
A17	8300-723-1	CONSTANT CURRENT SOURCE BOARD	16067		42
A18	8300-722-1	MOTHER BOARD	16067		43
A19	8300-725-1	OVERRANGE BOARD	16067		44
					45
					46
C1	Z5U	CAPACITOR .01 μf	56289	6-10086	47
C2	Z5U	CAPACITOR .01 μf	56289	6-10086	48
					49
					50
					51
F1	313.200	FUSE .2A S.B.	75915	2-40310	52
F2	AGX	FUSE .2A	71400	2-40288	53
					54
					55
					56
J1		NOT USED			57
J2		NOT USED			58
J3	AC3	RECEPTACLE PWR. CORD	82389	4-10111	59
J4	60GA4F	RECEPTACLE	82389	4-10108	60
J5	28JR106-1	BNC CONNECTOR	24931	4-10091	61
					62
					63
L1	6302	CHOKE 2.5 Mh	76493	5-90001	64
L2	6302	CHOKE 2.5 Mh	76493	5-90001	65
					66
					67
					68
R1	4330	RESISTOR 1Ω 3 1/4W	91637	5-50002	69
R2	RC07GF184J	RESISTOR 180K 1/4W 5%	JEDEC	5-10106	70
					71
					72

MODEL	CALICO P/N	ASSY R.O
8303	8300-404	

TITLE	SHT	OF
DIGITAL OHMMETER	4	5

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | # PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
S1	46206LF	POWER MODE SWITCH	82389	2-40298	73
S2	54-61681-26A1H	POWER SWITCH	87034	2-40126	74
					75
					76
XF1	342012	FUSE HOLDER	75915	2-40261	77
					78
					79
					80
	J52306	PUSH BUTTON	71590	2-40292	81
	129515	ANGLE BRACKET	73734		82
	1416-4	TERMINAL LUG	83330		83
	608	HOLE PLUG	83330		84
	2161	#4 NYLON WASHER	83330		85
	N440-3/8	NYLON SCREW, P. HD.	75987		86
	N440-5/16	NYLON SCREW, FLAT HD.	75987		87
	N440-X	NYLON NUT	75987		88
					89
					90
					91
	4-40 1/4 LG.	SCREW, PAN HEAD			92
	6-32 3/4 LG.	SCREW, PAN HEAD			93
	4-40 1/4 LG.	SCREW, FLAT HEAD			94
	6-32 3/4 LG.	SCREW, FLAT HEAD			95
					96
					97
	#4	WASHER, INT. STAR			98
	#6	WASHER, INT. STAR			99
					100
					101
	#4-40	NUT			102
	#6-32	NUT			103
	97348	FINGER STRIP 3/8 WIDE	30817		104
	(Must be purchased in 10 ft. long = Approximately 333 Pcs.)				105
	24 AWG	BUSS WIRE			106
		TEFLON SLEEVING FOR 24 AWG WIRE			107
					108

MODEL 8303 | CALICO P/N 8300-404 | ASSY R.O.

TITLE DIGITAL OHMMETER | SHT 5 OF 5

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	8300-405	Model 8300 Accessory Kit	16067		1
	(Following items to be bagged and shipped with unit)				2
					3
					4
					5
	17258S	Power Cord	70903	2-41094	6
	8300-801-1	Input Cable Assy	16067	1-42074	7
					8
					9
	313.100	Fuse .1A S.B.	75915	2-40316	10
					11
					12
					13
	2525	Alignment Tool	00194	2-41098	14
					15
					16
					17
	Model 8303	Instruction Manual	16067		18

MODEL	CALICO P/N	ASSY R.O
8303	8300-405	

TITLE	SHT	OF
MODEL 8303 ACCESSORY KIT	2	2

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A2	8300-700	ANALOG + DECADE BOARD	16067	16067	1
	-7	P.C. BOARD	16067	1-55035	2
					3
					4
A2C1	CIC-101	CAPACITOR .05μf	16067	6-10491	5
A2C2	CK-502	CAPACITOR .005μf	71590	6-10078	6
A2C3	DD201	CAPACITOR 200pf	71590	6-10461	7
A2C4	TE-1207	CAPACITOR 25μf 25V	04062	6-10355	8
A2C5	TE-1116	CAPACITOR 15μf 10V	56289	6-10462	9
A2C6	CM05C050K03	CAPACITOR 5pf	04062	6-10483	10
A2C7	5C023105X0250B3	CAPACITOR 1μf	56289	6-10440	11
A2C8	CK-102	CAPACITOR .001μf	71590	6-10459	12
A2C9	CK-503	CAPACITOR .05μf	71590	6-10460	13
A2C10	TE-1207	CAPACITOR 25μf 25V	04062	6-10355	14
A2C11	DM-15-471F	CAPACITOR 470 pf	04062	6-10519	15
A2CR1	CIC-704	DIODE ZENER	16067	3-10142	16
A2CR2	IN914	DIODE	JEDEC	3-10118	17
A2CR3	IN5227	DIODE ZENER	04713	3-10136	18
A2CR4	IN914	DIODE	JEDEC	3-10118	19
A2CR5	IN914	DIODE	JEDEC	3-10118	20
A2CR6	IN914	DIODE	JEDEC	3-10118	21
A2CR7	IN914	DIODE	JEDEC	3-10118	22
A2CR8	IN914	DIODE	JEDEC	3-10118	23
A2CR9	IN914	DIODE	JEDEC	3-10118	24
					25
A2DS1	B5750	NIXIE TUBE	83594	2-30031	26
A2DS2	B5750	NIXIE TUBE	83594	2-30031	27
A2DS3	B5750	NIXIE TUBE	83594	2-30031	28
A2DS4	B5750	NIXIE TUBE	83594	2-30031	29
A2DS5	B5750	NIXIE TUBE	83594	2-30031	30
A2DS6	B5856	NIXIE TUBE POL.	83594	2-30036	31
					32
A2IC1	CIC-200-4	I. C.	16067	3-30007	33
A2IC2	811CE	I. C.	0000B	3-30128	34
A2IC3	811CE	I. C.	0000B	3-30128	35
A2IC4	MC789P	I. C.	04713	3-30112	36

MODEL 8300 | CALICO P N 8300-700 | ASSY R.O. A2

TITLE ANALOG + DECADE BOARD ASSY | SHT 4 OF 7

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A2IC5	MC724P	I. C.	04713	3-30111	37
A2IC6	MC724P	I. C.	04713	3-30111	38
A2IC7	MC724P	I. C.	04713	3-30111	39
A2IC8	U6B996079X	I. C.	07263	3-30116	40
A2IC9	U6A995979X	I. C.	07263	3-30115	41
A2IC10	U5B995879X	I. C.	07263	3-30114	42
A2IC11	U5B995879X	I. C.	07263	3-30114	43
A2IC12	U6B996079X	I. C.	07263	3-30116	44
A2IC13	U6A995979X	I. C.	07263	3-30115	45
A2IC14	U5B995879X	I. C.	07263	3-30114	46
A2IC15	U6B996079X	I. C.	07263	3-30116	47
A2IC16	U6A995979X	I. C.	07263	3-30115	48
A2IC17	U5B995879X	I. C.	07263	3-30114	49
A2IC18	U6B996079X	I. C.	07263	3-30116	50
A2IC19	U6A995979X	I. C.	07263	3-30115	51
A2IC20	U5B995879X	I. C.	07263	3-30114	52
A2IC21	MC790P	I. C.	04713	3-30113	53
A2IC22	MC789P	I. C.	04713	3-30112	54
					55
A2Q1	2N3638	TRANSISTOR	07263	3-30094	56
A2Q2	CIC 336	TRANSISTOR	16067	3-30015	57
A2Q3	TIS43	UNIJUNCTION	16067	3-30131	58
A2Q4	2N3440	TRANSISTOR	07263	3-30090	59
A2Q5	2N3440	TRANSISTOR	07263	3-30090	60
A2Q6	2N3440	TRANSISTOR	07263	3-30090	61
A2Q7	2N3440	TRANSISTOR	07263	3-30090	62
					63
A2R1	T. B. D.	RESISTOR 3300A-014 .05%	16067		64
A2R2	3257W-1-502	POT 5K	80294	5-70081	65
A2R3	RC07GF101J	RESISTOR 100Ω 1/4W 5%	JEDEC	5-10029	66
A2R4	RC07GF153J	RESISTOR 15K 1/4W 5%	JEDEC	5-10080	67
A2R5	3300A-014-42	RESISTOR 599.7K .05%	16067	5-80072	68
A2R6	T. B. D.	RESISTOP RN60D 1%			69
A2R7	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	70
A2R8	RC07GF106J	RESISTOR 10M 1/4W 5%	JEDEC	5-10135	71
A2R9	RC07GF106J	RESISTOR 10M 1/4W 5%	JEDEC	5-10135	72

MODEL 8300 — CALICO P/N 8300-700 — ASSY R.O. A2

TITLE ANALOG + DECADE BOARD ASSY — SHT 5 OF 7

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A2R10	RC07GF275J	RESISTOR 2.7M1/4W 5%	JEDEC	5-10127	73
A2R11	3255W-1-103	POT 10K	80294	5-70087	74
A2R12	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	75
A2R13	RC07GF272J	RESISTOR 2.7K 1/4W 5%	JEDEC	5-10062	76
A2R14	RC07GF101J	RESISTOR 100Ω 1/4W 5%	JEDEC	5-10029	77
A2R15	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	78
A2R16	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	79
A2R17	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	80
A2R18	T.B.D.	RESISTOR RC07GF	JEDEC		81
A2R19	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	82
A2R20	RC07GF154J	RESISTOR 150K 1/4W 5%	JEDEC	5-10104	83
A2R21	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	84
A2R22	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	85
A2R23	3255W-1-103	POT 10K	80294	5-70087	86
A2R24	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	87
A2R25	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	88
A2R26	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	89
A2R27	RC07GF104J	RESISTOR 100K 1/4W 5%	JEDEC	5-10100	90
A2R28	RC07GF104J	RESISTOR 100K 1/4W 5%	JEDEC	5-10100	91
A2R29	RC07GF183J	RESISTOR 18K 1/4W 5%	JEDEC	5-10082	92
A2R30	RC07GF183J	RESISTOR 18K 1/4W 5%	JEDEC	5-10082	93
A2R31	RC07GF183J	RESISTOR 18K 1/4W 5%	JEDEC	5-10082	94
A2R32	RC07GF183J	RESISTOR 18K 1/4W 5%	JEDEC	5-10082	95
A2R33	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	96
A2R34	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	97
A2R35	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	98
A2R36	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	99
A2R37	RC07GF183J	RESISTOR 18K 1/4W 5%	JEDEC	5-10082	100
A2R38	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	101
A2R39	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	102
A2R40	RC07GF183J	RESISTOR 18K 1/4W 5%	JEDEC	5-10082	103
A2R41	T.B.D.	RESISTOR RN60D			104
A2R42	RC07GF100J	RESISTOR 10Ω 1/4W 5%	JEDEC	5-10005	105
A2R43	RC07GF432J	RESISTOR 4.3K 1/4W 5%	JEDEC	5-10067	106
					107
A2Y1	CR-18A/L	CRYSTAL 2 MHz	13454	3-30124	108

MODEL 8300 | CALICO P/N 8300-700 | ASSY R.O. A2

TITLE ANALOG + DECADE BOARD ASSY | SHT 6 OF 7

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | # PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	24 AWG	BUSS WIRE			109
		TEFLON SLEEVING FOR #24 WIRE			110
					111
	RCTO5075-7A	TRANS. PAD		2-40296	112
					113
	02-037-701-9-200-009	ELCO PIN	91662	2-40304	114
	02-013-701-9-200-009	ELCO PIN	91662	2-40326	115
	62-5204-41-12	ELCO GUIDE PIN	91662	2-40301	116

MODEL	CALICO P/N	ASSY R.O.
8300	8300-700	A2
TITLE ANALOG + DECADE BOARD ASSY	SHT 7 OF 7	

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A8	8300-705	FILTER BD.	16067		1
	-7	P.C. BD.	16067	1-55039	2
	SEE SHT. 3	EYELET			3
					4
A8C1	ZD5A104	CAPACITOR .1μf .5%	12406	6-10466	5
A8C2	ZD5A104	CAPACITOR .1μf .5%	12406	6-10466	6
A8C3	ZD5A104	CAPACITOR .1μf .5%	12406	6-10466	7
A8C4	CK 102	CAPACITOR .001μf	71590	6-10459	8
					9
A8CR1	FD300	DIODE	02335	3-10007	10
A8CR2	FD300	DIODE	02335	3-10007	11
					12
A8Q1	CIC 360	TRANSISTOR	16067	3-30129	13
A8Q2	2N3638	TRANSISTOR	07263	3-30094	14
A8Q3	2N3566	TRANSISTOR	07263	3-30091	15
					16
A8R1	RC07GF473J	RESISTOR 47K 1/4W 5%	JEDEC	5-10092	17
A8R2	3300A-014-45	RESISTOR 45.92K .1%	16067	5-80089	18
A8R3	3300A-014-45	RESISTOR 45.92K .1%	16067	5-80089	19
A8R4	RC07GF473J	RESISTOR 47K 1/4W 5%	JEDEC	5-10092	20
A8R5	2387-200Ω	POT 200Ω	91637	5-70092	21
A8R6	RN60D3741F	RESISTOR 3.74K 1%	JEDEC	5-60044	22
A8R7	T.B.D.	RESISTOR RC07GF	JEDEC		23
A8R8	RC07GF683J	RESISTOR 68K 1/4W 5%	JEDEC	5-10096	24
A8R9	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	25
A8R10	RC07GF391J	RESISTOR 390Ω 1/4W 5%	JEDEC	5-10043	26
A8R11	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	27
A8R12	RC07GF472J	RESISTOR 4.7K 1/4W 5%	JEDEC	5-10068	28
	4-40 1/4 LG.	SCREW, PAN HD.			29
A8TP1	430-108	TEST POINT BRN.	83330	2-41089	30
A8TP2	430-103	TEST POINT BLK.	83330	2-41088	31
A8TP3	430-102	TEST POINT RED	83330	2-41085	32
	#4	WASHER, INT. STAR			33
	60-5001-19-13	ELCO PIN	91662	2-40290	34
	4-40	HEX NUT			35
	8300-219-7	SHIELD	16067	1-42044	36

MODEL	CALICO P/N	ASSY R.O.
8300	8300-705	
TITLE: FILTER BD. ASSY	SHT 4 OF 4	A8

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A10	8300-703	PRE-AMP BOARD	16067		1
	-7	P.C. BOARD	16067	1-55037	2
	SEE SHT. 3	STAND OFF			3
A10C1	192P-47392	CAPACITOR .047 µf	56289	6-10465	4
A10C2	AJAX TYPE PPW	CAPACITOR .0022 µf	AJAX	6-10238	5
A10C3	CMO5F221J03	CAPACITOR 220 pf	04062	6-10036	6
A10C4	DM-15-471F	CAPACITOR 470 pf	04062	6-10519	7
A10C5	CMO5E750J03	CAPACITOR 75 pf	04062	6-10020	8
A10C6	TE 1155	CAPACITOR 10/15V	56289	6-10335	9
A10C7	DM10-020	CAPACITOR 2 pf	04062	6-10001	10
A10C8	TE 1155	CAPACITOR 10/15V	56289	6-10335	11
A10C9	TE 1155	CAPACITOR 10/15V	56289	6-10335	12
A10C10	TE 1155	CAPACITOR 10/15V	56289	6-10335	13
A10C11	CK 103	CAPACITOR .01 µf	71590	6-10094	14
A10C12	IDP-1-333	CAPACITOR .033 µf 5%	04062	6-10512	15
A10C13	CMO5F201J03	CAPACITOR 200 pf	04062	6-10282	16
A10C14	CK502	CAPACITOR .005 µf	71590	6-10078	17
A10C15	CK502	CAPACITOR .005 µf	71590	6-10078	18
A10C16	5C023105X0250B3	CAPACITOR 1/25V	56289	6-10440	19
A10C17	CMO5F201J03	CAPACITOR 200 pf	04062	6-10282	20
A10C18	TE 1209	CAPACITOR 50/25V	56289	6-10368	21
A10C19	TE 1209	CAPACITOR 50/25V	56289	6-10368	22
A10C20	IDP-1-203	CAPACITOR .02 µf	04062	6-10100	23
A10C21	VX5A273J	CAPACITOR .027µf 50V 5%	12406	6-10511	24
A10C22	CK 103	CAPACITOR .01µf	71590	6-10094	25
A10C23	CK502	CAPACITOR .005 µf	71590	6-10078	26
A10CR1	IN 5231A	DIODE ZENER	04713	3-10143	27
A10CR2	IN 5234A	DIODE ZENER	04713	3-10130	28
A10CR3	IN 914	DIODE	JEDEC	3-10118	29
A10CR4	IN 914	DIODE	JEDEC	3-10118	30
A10CR5	IN 914	DIODE	JEDEC	3-10118	31
A10CR6	IN 914	DIODE	JEDEC	3-10118	32
A10CR7	IN 914	DIODE	JEDEC	3-10118	33
A10CR8	IN 5234A	DIODE ZENER	04713	3-10130	34
A10CR9	IN 5234A	DIODE ZENER	04713	3-10130	35
A10CR10	IN 5234A	DIODE ZENER	04713	3-10130	36

MODEL 8300 | CALICO P/N 8300-703 | ASSY R.O. A10

TITLE PRE-AMP BOARD, ASSY | SHT 4 OF 6

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A10IC1	CIC-200-1	INTEGRATED CKT.	16067	3-30134	37
A10IC2	CIC-200-1	INTEGRATED CKT.	16067	3-30134	38
A10IC3	CIC-200-2	INTEGRATED CKT.	16067	3-30006	39
					40
A10L1	1537-90	CHOKE 200 μh	76493	5-90005	41
A10L2	1537-90	CHOKE 200 μh	76493	5-90005	42
					43
A10Q1	CIC-360	TRANSISTOR	16067	3-30129	44
A10Q2	2N4351	MOS F.E.T.	04713	3-30127	45
A10Q3	2N3566	TRANSISTOR	07263	3-30091	46
A10Q4	NOT BEING USED	TRANSISTOR			47
A10Q5	2N3566	TRANSISTOR	07263	3-30091	48
A10Q6	2N1304	TRANSISTOR	01295	3-30117	49
					50
A10R1	RC07GF104J	RESISTOR 100K 1/4W 5%	JEDEC	5-10100	51
A10R2	RC07GF105J	RESISTOR 1M 1/4W 5%	JEDEC	5-10123	52
A10R3	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	53
A10R4	RC07GF153J	RESISTOR 15K 1/4W 5%	JEDEC	5-10080	54
A10R5	RC07GF821J	RESISTOR 820Ω 1/4W 5%	JEDEC	5-10051	55
A10R6	RC07GF226J	RESISTOR 22M 1/4W 5%	JEDEC	5-10139	56
A10R7	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	57
A10R8	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	58
A10R9	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	59
A10R10	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	60
A10R11	RC07GF101J	RESISTOR 100Ω 1/4W 5%	JEDEC	5-1C029	61
A10R12	RC07GF105J	RESISTOR 1M 1/4W 5%	JEDEC	5-10123	62
A10R13	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	63
A10R14	RC07GF153J	RESISTOR 15K 1/4W 5%	JEDEC	5-10080	64
A10R15	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	65
A10R16	RC07GF101J	RESISTOR 100Ω 1/4W 5%	JEDEC	5-10029	66
A10R17	RC07GF104J	RESISTOR 100K 1/4W 5%	JEDEC	5-10100	67
A10R18	3300A-014-5	RESISTOR 2K .01%	16067	5-80012	68
A10R19	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	69
A10R20	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	70
A10R21	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	71
A10R22	RN60D4221F	RESISTOR 4.22K 1%	JEDEC	5-60048	72

MODEL 8300 — CALICO P/N 8300-703 — ASSY R.O A10

TITLE PRE-AMP BD. ASSY — SHT 5 OF 6

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A10R23	RC07GF334J	RESISTOR 330K 1/4W 5%	JEDEC	5-10112	73
A10R24	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	74
A10R25	RC07GF226J	RESISTOR 22M 1/4W 5%	JEDEC	5-10139	75
A10R26	RN60D1002F	RESISTOR 10K 1%	JEDEC	5-60079	76
A10R27	RN60D2001F	RESISTOR 2K 1%	JEDEC	5-60029	77
A10R28	RN60D1002F	RESISTOR 10K 1%	JEDEC	5-60079	78
A10R29	RC07GF125J	RESISTOR 1.2M 1/4W 5%	JEDEC	5-10142	79
A10R30	3300A-014-43	RESISTOR 17.975 K .05%	16067	5-80073	80
A10R31	3300A-014-44	RESISTOR 197.75 K .05%	16067	5-80074	81
A10R32	6023P-1-500	POT 50Ω	07263	5-70075	82
A10R33	6023P-1-501	POT 500Ω	07263	5-70072	83
A10R34	RC07GF100J	RESISTOR 10Ω 1/4W 5%	JEDEC	5-10005	84
A10TP1	430-103	TEST POINT--BLK.	83330	2-41088	85
A10TP2	430-108	TEST POINT--BRN.	83330	2-41089	86
A10TP3	430-102	TEST POINT--RED	83330	2-41085	87
A10TP4	430-106	TEST POINT--ORN.	83330	2-41086	88
A10TP5	430-107	TEST POINT--YEL.	83330	2-41087	89
A10TP6	430-104	TEST POINT--GRN.	83330	2-41090	90
					91
	60-5001-19-13	ELCO PIN	91662	2-40290	92
	8300-214-1	SHIELD	16067	1-42043	93
	8300-216-7	CAN	16067	1-42042	94
	RCTO5075-7A	TRANS. PAD		2-40296	95
					96
	6-32 3/8 LG.	SCREW, NYLON RND HEAD			97
	4-40 3/16 LG.	SCREW, PAN HEAD			98
	#4	WASHER, INT. STAR			99
					100
	4-40 3/16 Long	SCREW, NYLON PAN HEAD			101
	4-40	NUT, NYLON			102
	#4	WASHER, NYLON			103

MODEL	8300	CALICO P/N	8300-703	ASSY R.O.
TITLE	PRE-AMP BD. ASSY	SHT 6 OF 6		A10

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A11	8300-713	POWER SUPPLY #13	16067		1
	-7	P.C. BOARD	16067	1-55047	2
					3
					4
A11C1	DD-201	CAPACITOR 200 pf	71590	6-10461	5
A11C2	DD-201	CAPACITOR 200 pf	71590	6-10461	6
A11C3	CK-502	CAPACITOR .005	71590	6-10078	7
A11C4	CK-502	CAPACITOR .005	71590	6-10078	8
A11C5	CK-103	CAPACITOR .01	71590	6-10094	9
A11C6	CK-103	CAPACITOR .01	71590	6-10094	10
A11C7	TE-1209	CAPACITOR 50μf/25V	56289	6-10368	11
A11C8	TE-1209	CAPACITOR 50μf/25V	56289	6-10368	12
					13
A11CR1	IN5227	DIODE ZENER	04713	3-10136	14
A11CR2	IN5227	DIODE ZENER	04713	3-10136	15
A11CR3	IN914	DIODE	JEDEC	3-10118	16
A11CR4	IN914	DIODE	JEDEC	3-10118	17
A11CR5	IN914	DIODE	JEDEC	3-10118	18
A11CR6	IN914	DIODE	JEDEC	3-10118	19
A11CR7	IN5234A	DIODE ZENER	04713	3-10130	20
A11CR8	IN5234A	DIODE ZENER	04713	3-10130	21
A11CR9	IN5234A	DIODE ZENER	04713	3-10130	22
A11CR10	IN5234A	DIODE ZENER	04713	3-10130	23
A11CR11	IN914	DIODE	JEDEC	3-10118	24
A11CR12	IN914	DIODE	JEDEC	3-10118	25
A11CR13	IN914	DIODE	JEDEC	3-10118	26
A11CR14	IN914	DIODE	JEDEC	3-10118	27
					28
A11IC1	CIC-200-1	I.C.	16067	3-30134	29
A11IC2	CIC-200-1	I.C.	16067	3-30134	30
					31
A11Q1	2N3638	TRANSISTOR	07263	3-30094	32
A11Q2	2N3566	TRANSISTOR	07263	3-30091	33
A11Q3	2N2102	TRANSISTOR	95303	3-30075	34
A11Q4	2N4036	TRANSISTOR	95303	3-30106	35
					36

MODEL	8300	CALICO P/N	8300-713	ASSY R.O.
TITLE	POWER SUPPLY #3 BD. ASSY	SHT 4	OF 5	A11

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A11R1	RC07GF751J	RESISTOR 750Ω 1/4W 5%	JEDEC	5-10050	37
A11R2	RC07GF751J	RESISTOR 750Ω 1/4W 5%	JEDEC	5-10050	38
A11R3	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	39
A11R4	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	40
A11R5	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	41
A11R6	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	42
A11R7	RC07GF221J	RESISTOR 220Ω 1/4W 5%	JEDEC	5-10037	43
A11R8	RC07GF221J	RESISTOR 220Ω 1/4W 5%	JEDEC	5-10037	44
A11R9	RC07GF47ŗ1J	RESISTOR 4.7Ω 1/4W 5%	JEDEC	5-10002	45
A11R10	RC07GF100J	RESISTOR 10Ω 1/4W 5%	JEDEC	5-10005	46
A11R11	RC07GF302J	RESISTOR 3K 1/4W 5%	JEDEC	5-10063	47
A11R12	RC07GF123J	RESISTOR 12K 1/4W 5%	JEDEC	5-10078	48
A11R13	RC07GF123J	RESISTOR 12K 1/4W 5%	JEDEC	5-10078	49
A11R14	RC07GF302J	RESISTOR 3K 1/4W 5%	JEDEC	5-10063	50
					51
					52
	60-5001-19-13	ELCO PIN	91662	2-40290	53
	RCTO5075-7A	TRANSI PAD		2-40297	54
					55
	TXBF-032-025B	HEATSINK	98978	2-41048	56

MODEL	8300	CALICO P/N	8300-713	ASSY R.O.
TITLE	POWER SUPPLY #3 BD. ASSY	SHT	5 OF 5	A11

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | # PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A12	8300-712	POWER SUPPLY #2	16067		1
	-7	P.C. BOARD	16067	1-55046	2
	SEE SHT. 3	STAND OFF			3
					4
A12C1	BR-2000-15	CAPACITOR 2000μf 15V	14655	6-10403	5
A12C2	BR-2000-15	CAPACITOR 2000μf 15V	14655	6-10403	6
A12C3	DD-201	CAPACITOR 200 pf	71590	6-10461	7
A12C4	CK-502	CAPACITOR .005μf	71590	6-10078	8
					9
					10
A12CR1	SCE-1	DIODE	14099	3-10082	11
A12CR2	SCE-1	DIODE	14099	3-10082	12
A12CR3	SCE-1	DIODE	14099	3-10082	13
A12CR4	SCE-1	DIODE	14099	3-10082	14
A12CR5	IN914	DIODE	JEDEC	3-10118	15
A12CR6	IN914	DIODE	JEDEC	3-10118	16
A12CR7	IN914	DIODE	JEDEC	3-10118	17
					18
					19
A12IC1	CIC-200-1	I.C.	16067	3-30134	20
					21
					22
A12Q1	2N2102	TRANSISTOR	95303	3-30075	23
A12Q2	2N3767	TRANSISTOR	04713	3-30103	24
					25
					26
A12R1	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	27
A12R2	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	28
A12R3	RN60D1502F	RESISTOR 15K 1%	JEDEC	5-60193	29
A12R4	RS-2B	RESISTOR .5Ω	91637	5-50010	30
A12R5	RN60D3651F	RESISTOR 3.65K 1%	JEDEC	5-60191	31
					32
	4-40 1/4 LG.	SCREW			33
	60-5001-19-13	ELCO PIN	91662	2-40290	34
	#4	WASHER INT. STAR			35
	#4	WASHER, FLAT			36

MODEL 8300 | CALICO P/N 8300-712 | ASSY R.O. A12

TITLE POWER SUPPLY #2 BD. ASSY | SHT 4 OF 4

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A13	8300-711	POWER SUPPLY #1	16067		1
	-7	P.C. BOARD	16067	1-55045	2
					3
					4
A13C1	TC 58A	CAPACITOR 40μf/250V	76055	6-10179	5
A13C2	BR250-50	CAPACITOR 250μf/50V	14655	6-10395	6
A13C3	BR250-50	CAPACITOR 250μf/50V	14655	6-10395	7
A13C4	TE-1305	CAPACITOR 20μf/50V	56289	6-10348	8
					9
					10
A13CR1	SCE-6	DIODE	14099	3-10078	11
A13CR2	SCE-6	DIODE	14099	3-10078	12
A13CR3	SCE-6	DIODE	14099	3-10078	13
A13CR4	SCE-6	DIODE	14099	3-10078	14
A13CR5	SCE-2	DIODE	14099	3-10079	15
A13CR6	SCE-2	DIODE	14099	3-10079	16
A13CR7	SCE-2	DIODE	14099	3-10079	17
A13CR8	SCE-2	DIODE	14099	3-10079	18
A13CR9	SCE-2	DIODE	14099	3-10079	19
A13CR10	SCE-2	DIODE	14099	3-10079	20
A13CR11	SCE-2	DIODE	14099	3-10079	21
A13CR12	SCE-2	DIODE	14099	3-10079	22
					23
					24
A13R1	RC20GF104J	RESISTOR 100K 1/2W	JEDEC	5-20077	25
					26
					27
	60-5001-19-13	ELCO PIN	91662	2-40290	28

MODEL	CALICO P/N		ASSY R.O.
8300	8300-711		
TITLE	POWER SUPPLY #1 BD. ASSY	SHT 4 OF 4	A13

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A16	8300-724	POWER SUPPLY BOARD	16067		1
	-7	P. C. BOARD	16067	1-55060	2
					3
					4
A16C1	BR250-50	CAPACITOR 250μf 50V	14655	6-10395	5
A16C2	BR1000-50	CAPACITOR 1000μf 50V	14655	6-10529	6
					7
					8
A16CR1	SCE-1	DIODE	14099	3-10082	9
A16CR2	SCE-1	DIODE	14099	3-10082	10
A16CR3	SCE-1	DIODE	14099	3-10082	11
A16CR4	SCE-1	DIODE	14099	3-10082	12
					13
					14
	60-5001-19-13	ELCO PIN	91662	2-40290	15

MODEL 8303 | CALICO P N 8300-724 | ASSY R.O. A16

TITLE POWER SUPPLY BOARD | SHT 4 OF 4

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A17	8300-723	CONSTANT CURRENT SOURCE	16067		1
	-7	P. C. BOARD	16067	1-55059	2
					3
					4
A17C1	192P10492	CAPACITOR .1	56289	6-10132	5
A17C2	WMF 2S47	CAPACITOR .047	14655	6-10228	6
A17C3	WMF 2S1	CAPACITOR .01	14655	6-10091	7
A17C4	CK 502	CAPACITOR .005	71590	6-10078	8
A17C5	CM05F221J03	CAPACITOR 220 pf	04062	6-10036	9
A17C6	CK 502	CAPACITOR .005	71590	6-10078	10
A17C7	192P10492	CAPACITOR .1	56289	6-10132	11
					12
A17CR1	FD 300	DIODE	02335	3-10007	13
A17CR2	FD 300	DIODE	02335	3-10007	14
A17CR3	IN 914	DIODE	JEDEC	3-10118	15
A17CR4	IN 914	DIODE	JEDEC	3-10118	16
A17CR5	IN 914	DIODE	JEDEC	3-10118	17
A17CR6	IN 5250	DIODE ZENER	04713	3-10134	18
A17CR7	IN 914	DIODE	JEDEC	3-10118	19
A17CR8	IN 5227	DIODE ZENER	04713	3-10136	20
A17CR9	IN 5240	DIODE ZENER	04713	3-10133	21
A17CR10	IN 914	DIODE	JEDEC	3-10118	22
A17CR11	IN 914	DIODE	JEDEC	3-10118	23
A17CR12	IN 914	DIODE	JEDEC	3-10118	24
A17CR13	IN 914	DIODE	JEDEC	3-10118	25
A17CR14	IN 5250	DIODE ZENER	04713	3-10134	26
A17CR15	SCE-4	DIODE	14099	3-10084	27
A17CR16	CIC 702-5	DIODE ZENER	16067	3-10168	28
A17CR17	IN 5234A	DIODE ZENER	04713	3-10130	29
A17CR18	IN 5227	DIODE ZENER	04713	3-10136	30
A17CR19	IN 914	DIODE	JEDEC	3-10118	31
A17IC1	CIC -200-2	I. C.	16067	3-30006	32
					33
A17Q1	CIC 336	TRANSISTOR	16067	3-30015	34
A17Q2	2N 3711	TRANSISTOR	01295	3-30098	35
A17Q3	CIC 330	TRANSISTOR	16067	3-30008	36

MODEL 8303 | CALICO P/N 8300-723 | ASSY R.O. A17

TITLE CONSTANT CURRENT SOURCE | SHT 4 OF 6

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | **PARTS LIST**

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A17Q4	2N3440	TRANSISTOR	95303	3-30090	37
A17Q5	MJ2252	TRANSISTOR	04713	3-30139	38
A17Q6	CIC 718	TRANSISTOR	16067	3-30041	39
					40
A17R1	RC07GF474J	RESISTOR 470K 1/4W 5%	JEDEC	5-10115	41
A17R2	RC07GF105J	RESISTOR 1 M 1/4W 5%	JEDEC	5-10123	42
A17R3	RC07GF472J	RESISTOR 4.7K1/4W 5%	JEDEC	5-10068	43
A17R4	RC07GF104J	RESISTOR 100K 1/4W 5%	JEDEC	5-10100	44
A17R5	RC07GF105J	RESISTOR 1M 1/4W 5%	JEDEC	5-10123	45
A17R6	RC07GF105J	RESISTOR 1M 1/4W 5%	JEDEC	5-10123	46
A17R7	RN70D1504F	RESISTOR 1.5M 1%	JEDEC	5-60180	47
A17R8	RC07GF153J	RESISTOR 15K 1/4W 5%	JEDEC	5-10080	48
A17R9	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	49
A17R10	RN60D4020F	RESISTOR 402Ω 1%	JEDEC	5-60010	50
A17R11	RC07GF512J	RESISTOR 5.1K1/4W 5%	JEDEC	5-10069	51
A17R12	RC07GF512J	RESISTOR 5.1K 1/4W 5%	JEDEC	5-10069	52
A17R13	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	53
A17R14	RC07GF102J	RESISTOR 1 K 1/4W 5%	JEDEC	5-10053	54
A17R15	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	55
A17R16	452E1535	RESISTOR 15K 5W	56289	5-50091	56
A17R17	RC07GF100J	RESISTOR 10Ω 1/4W 5%	JEDEC	5-10005	57
A17R18	EP-29	RESISTOR 603Ω .1%	07088	5-80105	58
A17R19	EP-27	RESISTOR 50Ω .01%	07088	5-80106	59
A17R20	6023P-1-204	POT 200K	02335	5-70103	60
A17R21	RN60D7502F	RESISTOR 75K 1%	JEDEC	5-60215	61
A17R22	RN60D5902F	RESISTOR 59K 1%	JEDEC	5-60120	62
A17R23	6023P-1-201	POT 200Ω	02335	5-70104	63
A17R24	T.B.D.	RESISTOR RN60D 1%			64
A17R25	T.B.D.	RESISTOR RN60D 1%			65
A17R26	6023P-1-501	POT 500Ω	02335	5-70072	66
A17R27	EP-27	RESISTOR 59.75K .1%	07088	5-80107	67
A17R28	EP-27	RESISTOR 5.975K .1%	07088	5-80108	68
A17R29	6023P-1-500	POT 50Ω	02335	5-70075	69
A17R30	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	70
A17R31	RN60D1501F	RESISTOR 1.5K 1%	JEDEC	5-60216	71
A17R32	RN60D4990F	RESISTOR 499Ω	JEDEC	5-60262	72

MODEL 8303 | CALICO P/N 8300-723 | ASSY R.O. A17

TITLE CONSTANT CURRENT SOURCE | SHT 5 OF 6

CALICO — CALIFORNIA INSTRUMENTS CORP., SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A17R33	6023P-1-104	POT 100K	02335	5-70102	73
A17R34	RN80C5954D	RESISTOR 5.95M .5%	JEDEC	5-80109	74
A17R35	78PR2M	POT 2M	73138	5-70105	75
A17R36	RN30X5905F	RESISTOR 59M 1%	JEDEC	5-60377	76
A17R37	EP-20	RESISTOR 597.5K .1%	07088	5-80111	77
A17R38	6023P-1-502	POT 5K	02335	5-70073	78
A17R39	RC07GF226J	RESISTOR 22M 1/4W 5%	JEDEC	5-10139	79
A17R40	RC07GF244J	RESISTOR 240K 1/4W 5%	JEDEC	5-10109	80
A17R41	RC07GF474J	RESISTOR 470K 1/4W 5%	JEDEC	5-10115	81
A17R42	RC20GF104J	RESISTOR 100K 1/2W 5%	JEDEC	5-10077	82
					83
	60-5001-19-13	ELCO PIN	91662	2-40290	84
					85
	1308B	TERMINAL	88245		86
					87
	4-40 1/4 LG.	SCREW, PAN HEAD			88
	#4	WASHER, INT. STAR			89
	4-40	NUT			90
					91
	RCT05075-7A	TRANSISTOR PAD	19080	120-4	92
	RCT018110-1A	TRANSISTOR PAD	19080	120-4	93
					94
	LB66B1B	HEATSINK	98978	2-41047	95

MODEL 8303 — CALICO P N 8300-723 — ASSY R.O. A17

TITLE CONSTANT CURRENT SOURCE — SHT 6 OF 6

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A18	8300-722	MOTHER BOARD ASSY	16067		1
	-7	P.C. BOARD	16067	1-55058	2
					3
					4
					5
A18R1		NOT USED			6
A18R2		NOT USED			7
A18R3	6023P-1-503	POT 50 K	02335	5-70074	8
					9
					10
					11
A18S1		NOT USED			12
A18S2		NOT USED			13
A18S3	8300-017	SWITCH-PUSH BUTTON	16067	2-40324	14
A18S4	8300-017	SWITCH-PUSH BUTTON	16067	2-40324	15
					16
					17
					18
A18T1	8300-016	TRANSFORMER	16067	7-10126	19
					20
					21
					22
	8300-237-7	MOTHER BD. STIFFENER	16067	1-42076	23
	8300-221-7	SHIELD	16067	1-42038	24
					25
					26
					27
	62-5201-33-17	POLARIZING SLEEVE	91662	2-40382	28
	352	HINGED STAND OFF	91833	2-40313	29
	9725-A-0440	STAND OFF 5/16 LG. x 4-40	06540	2-40311	30
	8083-A-0440	STAND OFF 5/8 LG. x 4-40	06540	2-40312	31
	62-5201-02-23	ELCO PIN	91662	2-40300	32
	62-5201-40-12	BD. GUIDE, RIGHT	91662	2-40302	33
	62-5201-40-22	BD. GUIDE, LEFT	91662	2-40303	34
	2073	RUBBER BUMPER	76348		35
	.200FSI.12A15	FLEX STRIP	15912	2-41096	36

MODEL 8303	CALICO P/N 8300-722		ASSY R.O. A18
TITLE MOTHER BOARD ASSEMBLY		SHT 4 OF 5	

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	5681-15	FUSE CLIP	71400	2-40291	37
	97438	FINGER STRIP 3/8 WIDE	30817		38
	(Must be purchased in 10 ft. long = Approximately 333 Pcs.)				39
					40
					41
					42
	BRASS RIVET RD. HD. HOLLOW 1/8 X 3/16 Lg.				43
	4-40 1/2 LG.	SCREW, PAN HEAD			44
	4-40 1/4 LG.	SCREW, PAN HEAD			45
	#4	WASHER, SPLIT LOCK			46
	6-32 5/16 LG.	SCREW, PAN HEAD			47
	#6	WASHER, INT. STAR			48

MODEL	CALICO P/N	ASSY R.O.
8303	8300-722	
TITLE: MOTHER BOARD ASSEMBLY	SHT 5 OF 5	A18

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | **PARTS LIST**

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A19	8300-725	OVERLOAD BOARD ASSY	16067		1
	-7	P.C. BOARD	16067	1-55064	2
					3
					4
A19CR1	IN 914	DIODE	JEDEC	3-10118	5
A19CR2	IN 914	DIODE	JEDEC	3-10118	6
A19CR3	IN 914	DIODE	JEDEC	3-10118	7
					8
					9
A19DS1	CG03-RCS-N120	LAMP	03797	2-41119	10
					11
A19IC1	MC 724P	IC	04713	3-30111	12
A19IC2	MC 724P	IC	04713	3-30111	13
A19IC3	MC 790P	IC	04713	3-30113	14
					15
A19Q1	2N3566	TRANSISTOR	07263	3-30091	16
A19Q2	2N3440	TRANSISTOR	95303	3-30090	17
					18
A19R1	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	19
A19R2	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	20
A19R3	RC07GF153J	RESISTOR 15K 1/4W 5%	JEDEC	5-10080	21
A19R4	RC07GF104J	RESISTOR 100K 1/4W 5%	JEDEC	5-10100	22
A19R5	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	23
A19R6	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	24
A19R7	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	25
A19R8	RC07GF474J	RESISTOR 470K 1/4W 5%	JEDEC	5-10115	26
A19R9	RC07GF104J	RESISTOR 100K 1/4W 5%	JEDEC	5-10100	27
					28
					29
A19XDS1	Q-082-4P	SOCKET--LAMP	03797	2-41120	30
					31
	02-007-372-5-200	ELCO PIN (Upper Tier)	91662	2-40328	32
	02-006-332-5-200	ELCO PIN (Lower Tier)	91662	2-40329	33
	62-5204-40-12	ELCO GUIDE SOCKET	91662	2-40315	34
					35
	24GA	BUSS WIRE			36

MODEL	CALICO P/N	ASSY R.O.
8300	8300-725	A19
TITLE OVERLOAD BOARD ASSEMBLY	SHT 4 OF 4	

APPENDIX A

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbook H4-1 and its latest supplement. Alphabetical codes have been arbitrarily assigned to supplier not appearing in the H4 handbook.

0000A	ElectriCord	Westfield, Pennsylvania
0000B	Tech. Prod. Sales	
00141	Pic Eng.	New York, New York
00544	Metal Cal	Inglewood, California
00656	Aero Vox	New Bedford, Massachusetts
00779	AMP, Inc.	Harrisburg, Pennsylvania
00853	Sangamo	Marion, Illinois
01121	Allen Bradley	Milwaukee, Wisconsin
01255	Litton Industries	Beverly Hills, California
01281	TRW Semiconductors, Inc.	Lawndale, California
01295	Texas Instruments	Dallas, Texas
02335	Fairchild	Hicksville, LI, NewYork
02660	Amphenol	Broadview, Illinois
03507	General Electric	Syracuse, New York
03508	General Electric	Syracuse, New York
03516	General Electric	Somersworth, New Hampshire
03797	Eldema	El Monte, California
03911	Clairex	New York, New York
04009	Arrow-Hart	Hartford, Connecticut
04062	Elmenco	New York, New York
04713	Motorola	Phoenix, Arizona
05276	Pomona	El Monte, California
05397	Kemet	Cleveland, Ohio
05820	Wakefield Engineering	Wakefield, Massachusetts
06184	Conelco	San Bernardino, California
06229	Electrovert, Inc.	Mt. Vernon, New York
06540	Amatom Elect. Hardware	New Rochelle, New York
07088	Kelvin Elect. Co.	Van Nuys, California
07256	Silicon Trans. Corp.	Garden City, New York
07263	Fairchild	Mt. View, California
07387	Bircher Corporation	Los Angeles, California
07556	Unitrack (Calabro Plastics)	Upper Darby, Pennsylvania
07716	IRC	Burlington, Iowa
08718	Cannon	Phoenix, Arizona
08730	Vermaline Products	Franklin Lakes, New Jersey
09026	Babcock	Costa Mesa, California
11432	Diamond Perforated Metals	Gardena, California
12405	Hysol	El Monte, California
12406	Elpac	Fullerton, California
12463	Amtronics Mfg. Inc.	Omaha, Nebraska
12697	Clarostat	Dover, New Hampshire
13454	Texas Crystals	River Grove, Illinois
14099	Semtech Corp.	Newbury Park, California
14655	Cornell-Dubilier Elect. Corp.	Newark, New Jersey
14752	Electrocube	S. Pasadena, California
15112	Electra Scientific	Fullerton, California
15801	Fenwal	Framingham, Massachusetts
15818	Amelco	Mt. View, California
15909	Daven	Livingston, New Jersey
15912	Digital Sensors, Inc.	Los Angeles, California
16067	California Instruments Corporation	San Diego, California
16758	Delco	Kokomo, Indiana
16902	Simpson	Escondido, California
17838	California General Corp. (Mektron)	Chula Vista, California
18722	RCA	Mountaintop, Pennsylvania
19080	The Robinson Company	Hawthorne, California
19781	Potter	Anaheim, California
21604	Buckeye Stamping Co.	Columbus, Ohio
22599	Elastic Stop Nut	Van Nuys, California
23936	Pamotor	San Francisco, California
24931	Specialty Conn. Co., Inc.	Indianapolis, Indiana
25684	Victoreen	Oaklawn, Illinois
26364	Component Corp.	Denville, New Jersey
26533	Zero	Burbank, California
26528	Lamcor	Anahiem, California
27556	IMB	Santa Fe Springs, California
28520	Heyman Mfg. Co. (Heyco)	Kenilworth, New Jersey
30086	ITE	Philadelphia, Pennsylvania
42190	Muter Co.	Chicago, Illinois
44655	Ohmite Mfg. Co.	Skokie, Illinois
46384	Penn. Eng.	Doylestown, Pennsylvania
56289	Sprague	North Adams, Massachusetts
58474	Superior Elect. Co.	Bristol, Connecticut
60741	Triplett	Bluffton, Ohio
70903	Belden	Chicago, Illinois
71002	Birnbach Radio	New York, New York
71279	Cambion	Cambridge, Massachusetts
71400	Bussman	St. Louis, Missouri
71450	CTS	Elkhart, Indiana
71468	ITT Cannon	Los Angeles, California
71590	Centralab	Milwaukee, Wisconsin
71785	Cinch-Jones	Chicago, Illinois
72619	Dialco	Brooklyn, New York
72982	Erie Reston Corp.	Erie, Pennsylvania
73138	Beckman	Fullerton, California
73559	Carling Electr. Inc.	W. Hartford, Connecticut
73734	Federal Screw Products	Chicago, Illinois
73899	JFD	Brooklyn, New York
73949	Guardian	Chicago, Illinois
74193	Heinemann	Trenton, New Jersey
74276	Signalite, Inc.	Neptune, New Jersey
74542	Hoyt	Penacook, New Hampshire
74545	Hubbel	Bridgeport, Connecticut
74970	E. F. Johnson	Waseca, Minnesota
75382	Kulka	Mt. Vernon, New York
75915	Littelfuse	Des Plaines, Illinois
75987	Weckesser Co.	Chicago, Illinois
76055	Mallory	Frankfort, India na
76348	Miller Products Co. Inc.	New York, New York
76493	J. W. Miller	Los Angeles, California
76854	Oak Mfg. Co.	Crystal Lake, Illinois
77342	Potter-Brumfield	Chicago, Illinois
*78526	Stanwyck Winding Co.	Newburg, New York
78290	Struthers-Dunn	Pitman, New Jersey
78488	Stackpole	St. Mary's, Pennsylvania
78553	Tinnerman Products	Cleveland, Ohio
78947	Ucinite Co.	Newtonville, Massachusetts
79727	Continental-Wirt	Philadelphia, Pennsylvania
79963	Zierick Mfg. Corp.	New Rochelle, New York
*00866	Goe Eng.	City of Industry, California
80112	G. C. Electronics	Los Angeles, California
80294	Bourns	Riverside, California
80368	Sylvania	New York, New York
81073	Grayhill	La Grange, Illinois
81095	Triad	Chicago, Illinois
81312	Winchester	Norwalk, Connecticut
82389	Switchcraft	Chicago, Illinois
82877	Rotron	Woostock, New York
83330	H. H. Smith	Brooklyn, New York
83594	Burroughs	Plainfield, New Jersey
83701	Elec. Devices, Inc.	Yonkers, New York
84171	Arco	Great Neck, New York
86684	RCA	Harrison, New Jersey
87034	Marco-Oak	Anaheim, California
88026	Cutler-Hammer	Los Angeles, California
88245	UseCo	Van Nuys, California
89665	UTC	Venice, California
90201	Mallory	Indianapolis, Indiana
91637	Dale	Columbus, Nebraska
91662	Elco	Willow Grove, Pennsylvania
91812	Janco Corp.	Burbank, California
91833	Keystone	New York, New York
91929	Micro Switch	Chicago, Illinois
92194	Alpha Wire	Chicago, Illinois
92219	Waldom	Chicago, Illinois
93332	Sylvania	Waburn, Massachusetts
94222	Southco	Chester, Pennsylvania
95146	Alco	Lawrence, Massachusetts
95303	RCA	Cincinnati, Ohio
96682	Genisco	Compton, California
98159	Rubber Teck Inc.	Gardena, California
98978	IERC	Burbank, California
99515	Electron Products	Pasadena, California
99517	Vasco	El Monte, California
99800	Delevan Elect. Corp.	Aurora, New York

* Out of numerical order.

APPENDIX B

DETAILED INSTRUCTIONS FOR

PRINT-OUT

OPTION "P"

SUB-ASSY A15

CALICO P/N 8300-710

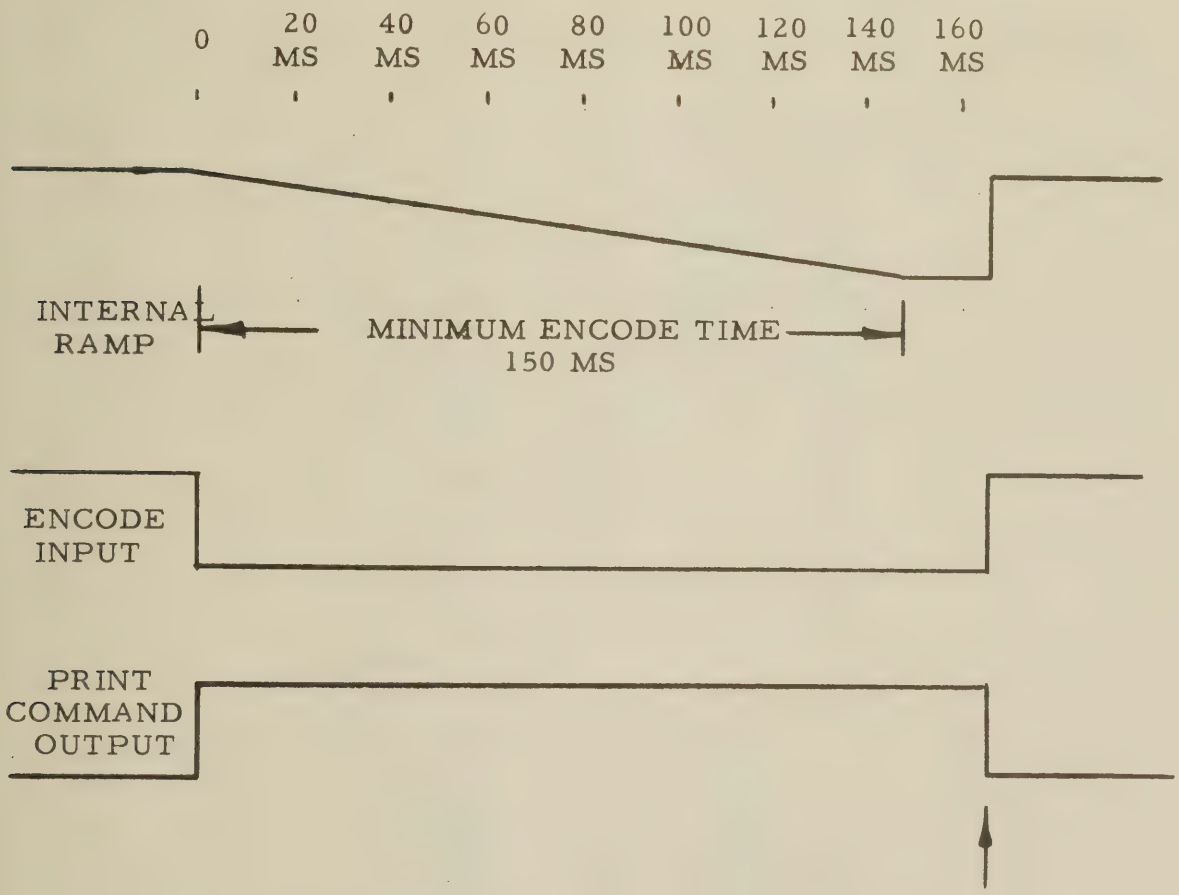
PRINT OUTPUT

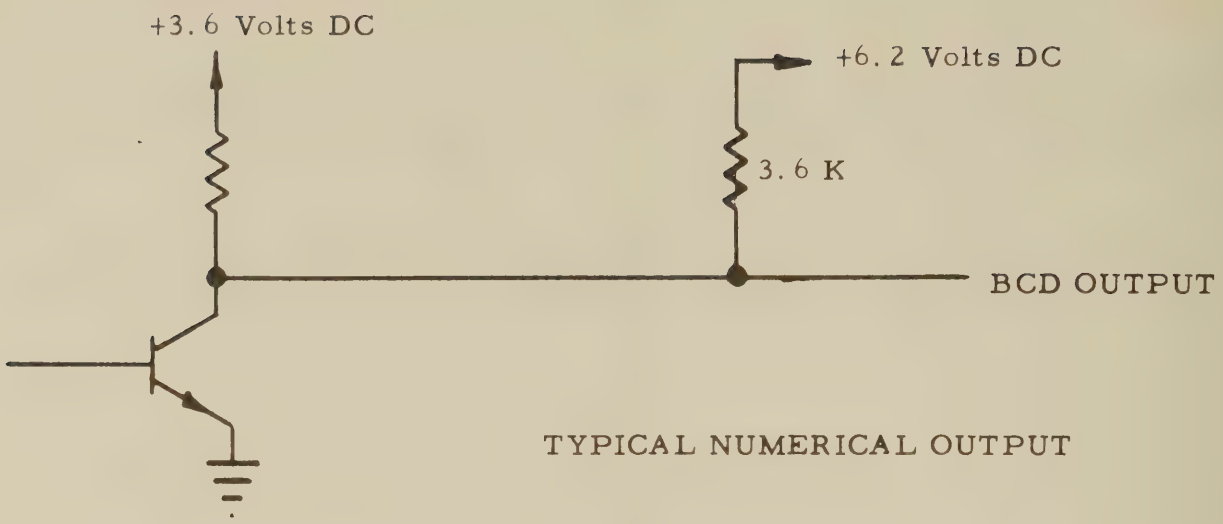
The 8300-710 print-out board contains the signal buffering and delay circuits required for most small system requirements. A schematic diagram is contained on drawing E8300-080.

All outputs that are required to operate a conventional printer are available at the 50 pin output connector J1 located on the rear panel. All encoding and delay inputs and outputs are available at the 14 pin output connector J2 located on the rear panel.

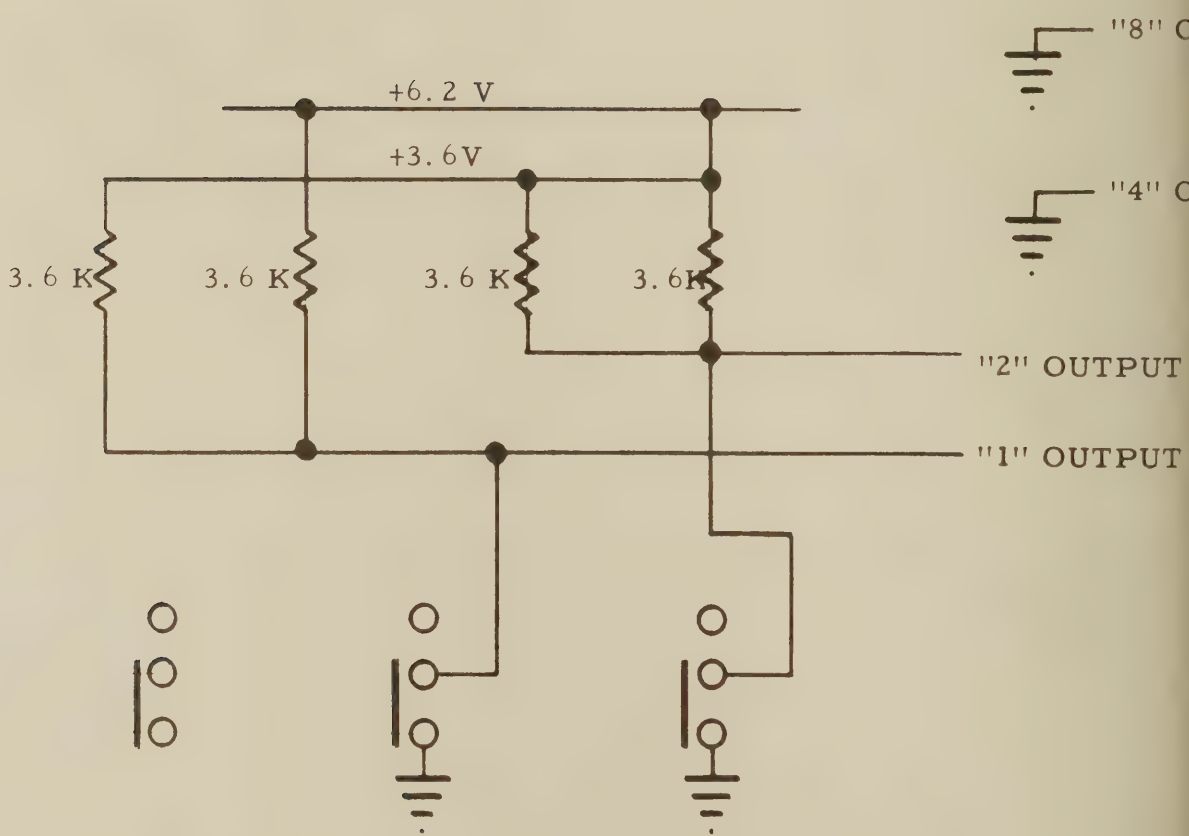
PRINT COMMAND

The print command output, J1 Pin 48 and J2 Pin 2, is used to start the printing sequence in the printing device. The negative going print command occurs at the instant the new data has been transferred into the output storage register. See timing drawing Figure 1.





TYPICAL NUMERICAL OUTPUT



RANGE or FUNCTION SWITCH

SIMPLIFIED SCHEMATIC

ENCODE INPUT

The encode cycle must have two time periods, an encode period and a restore period. The encode period is formed by driving J2 Pin 8 to ground. The restore period is formed by driving J2 Pin 8 positive. The encode period must be a minimum of 150 MS long. The restore period must be a minimum of 5 MS long.

Level limits:	Encode	0 volts ±.4 volts
	Restore	+2.7 volts ±.9 volts

The data gathered in the counters during the encode cycle is transferred into the storage register at the beginning of the restore cycle. It is, therefore, possible to gather and hold two sets of data in an 8303 simultaneously; one in the storage register being displayed and the other in the decode counters awaiting display.

DELAY CIRCUITS

The 8300-710 board contains two delay circuits; one fixed delay, the other a variable delay.

The fixed delay may be activated by pulsing J2 Pin 5 positive. As J2 Pin 5 goes positive, J2 Pin 12 turns on to ground. After approximately 250 MS, J2 Pin 12 returns to the positive state.

The input to the variable delay is brought out at J2 Pin 4. To start the delay J2 Pin 4 should be driven to +3.6 volts and J2 Pin 9 must be pulsed positive. This delay can be set to hold off for several seconds before resetting, or set to hold off for only 200 MS before resetting. This adjustment is A15R48.

8303 PRINT OUTPUT CODE SEQUENCE

The 8303 output code is "1-2-4-8" positive "1" state. The "1" state is +5 VDC ±10% at a source impedance of 1.8KΩ. The "0" state is 0 VDC ±.4 VDC at a maximum sink current of 5 MA DC.

	NUMERICAL REPRESENTATION	BCD OUTPUT
		1-2-4-8
TYPICAL DECADE	0	0 0 0 0
	1	1 0 0 0
	2	0 1 0 0
	3	1 1 0 0
	4	0 0 1 0
	5	1 0 1 0
	6	0 1 1 0
	7	1 1 1 0
	8	0 0 0 1
	9	1 0 0 1
RANGE SWITCH POSITION		
1	0	0 0 0 0
10	1	1 0 0 0
100	2	0 1 0 0
FUNCTION SWITCH POSITION		
Ω	0	0 0 0 0
KΩ	1	1 0 0 0
MΩ	2	0 1 0 0

REAR PANEL CONNECTOR "J1"

AMPHENOL BLUE RIBBON 50 PIN

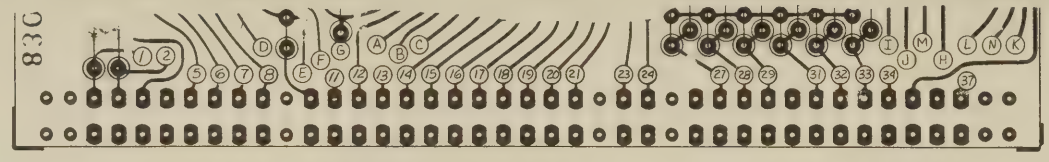
PIN NUMBER		OUTPUT
1	"1" BIT	
2	"2" BIT	
26	"4" BIT	UNITS DECADE
27	"8" BIT	
3	"1" BIT	
4	"2" BIT	
28	"4" BIT	TENS DECADE
29	"8" BIT	
5	"1" BIT	
6	"2" BIT	
30	"4" BIT	HUNDREDS
31	"8" BIT	DECADE
7	"1" BIT	
8	"2" BIT	
32	"4" BIT	THOUSANDS
33	"8" BIT	DECADE
9	"1" BIT *	
10	"2" BIT	TEN
34	"4" BIT	THOUSANDS
35	"8" BIT	DECADE
11	"1" BIT	
12	"2" BIT	RANGE
36	"4" BIT	SWITCH
37	"8" BIT	
13	"1" BIT	
14	"2" BIT	FUNCTION
38	"4" BIT	SWITCH
39	"8" BIT	

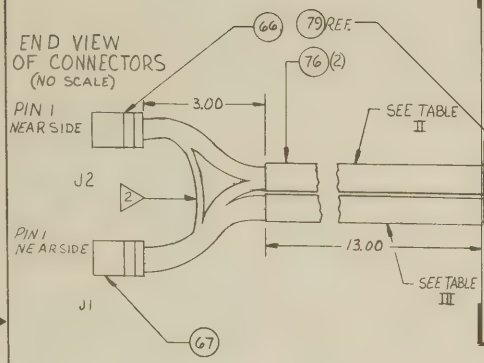
25	POSITIVE LOGIC REFERENCE
48	PRINT COMMAND (DIRECT COUPLED)
46	PRINT COMMAND (CAPACITIVE COUPLED)
24	GROUND
50	GROUND

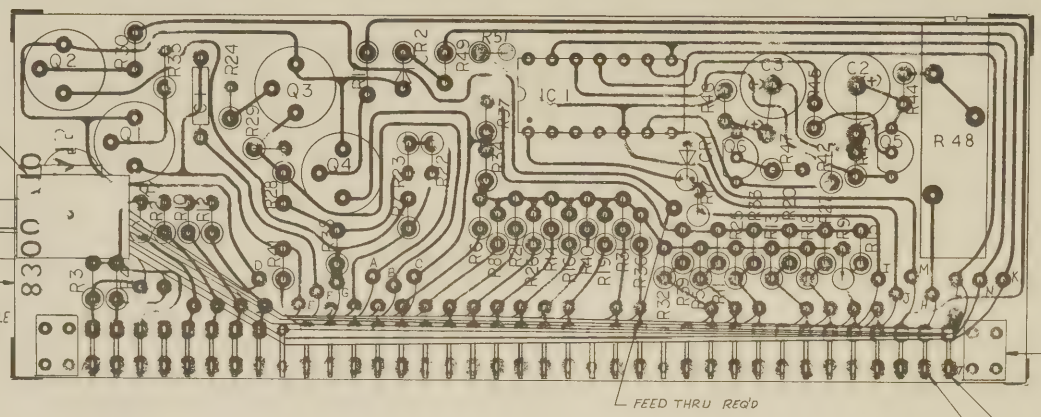
* Ten thousands "1" bit may be used as a range exceeded indication to void data above 09999.

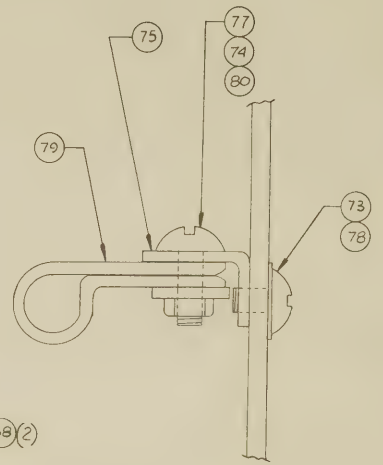
REAR PANEL CONNECTOR "J2"
AMPHENOL BLUE RIBBON 14 PIN

1	GROUND
2	PRINT COMMAND (NEGATIVE GOING)
3	ENCODE DRIVER OUTPUT
4	VARIABLE DELAY INPUT
5	FIXED DELAY RESET
6	FREQUENCY MODE INHIBIT
7	FIXED DELAY INVERTED OUTPUT
8	ENCODE INPUT
9	VARIABLE DELAY RESET
10	5 Hz TIME BASE OUTPUT
11	VARIABLE DELAY INVERTED OUTPUT
12	FIXED DELAY OUTPUT
13	+3.6 VOLT POWER SUPPLY
14	VARIABLE DELAY OUTPUT

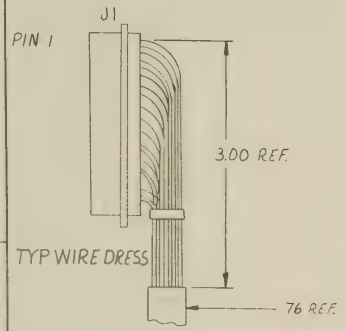








VIEW CABLE CLAMP INST.



A15
-1 ASSEMBLY
VIEW COMPONENT SIDE

TABLE II [3]

WIRE #	FROM	TO	COLOR	LENGTH
1	J1-50	J2-1	BRN	
2	J1-48	J2-2	RED	
3	A15-37	J2-3	ORN	
4	A15-H	J2-4	YEL	
5	A15-I	J2-5	GRN	
6	A15-11	J2-6	BLU	
7	A15-J	J2-7	VIO	
8	A15-13	J2-8	GRY	
9	A15-K	J2-9	WHT	
10	A15-34	J2-10	W/BLK	
11	A15-L	J2-11	W/BRN	
12	A15-M	J2-12	W/RED	
13	A15-12	J2-13	W/ORN	
14	A15-N	J2-14	W/YEL	
15	A15-21	J1-13	W/GRN	
16	A15-32	J1-14	W/BLU	
17	A15-33	J1-38	W/VIO	
18	A15-29	J1-11	W/GRY	
19	A15-28	J1-12	W/BLK/BRN	
20	A15-27	J1-36	W/BLK/RED	
21	A15-G	J1-9	W/BLK/ORN	

TABLE III [3]

WIRE #	FROM	TO	COLOR	LENGTH
22	A15-F	J1-46	W/BLK/YEL	
23	A15-E	J1-48	W/BLK/GRN	
24	A15-D	J1-10	W/BLK/BLU	
25	A15-A	J1-25	W/BLK/VIO	
26	A15-B	J1-16	W/BLK/GRY	
27	A15-C	J1-15	W/BRN/RED	
28	A15-21	J1-33	W/BRN/ORN	
29	A15-20	J1-32	W/BRN/GRN	
30	A15-24	J1-8	W/BRN/BLU	
31	A15-23	J1-7	W/BRN/VIO	
32	A15-17	J1-31	W/BRN/YEL	
33	A15-16	J1-30	BRN	
34	A15-19	J1-6	RED	
35	A15-18	J1-5	ORN	
36	A15-8	J1-29	YEL	
37	A15-7	J1-28	GRN	
38	A15-15	J1-4	BLU	
39	A15-14	J1-3	VIO	
40	A15-2	J1-27	GRY	
41	A15-1	J1-26	WHT	
42	A15-10	J1-2	W/BLK	
43	A15-5	J1-1	W/BRN	

TABLE I
JUMPER WIRE INST.

FROM	TO
J1-10	J1-34
J1-34	J1-35
J1-25	J1-27
J1-37	J1-39
J1-39	J1-40
J1-40	J1-41
J1-41	J1-24
J1-21	J1-50

[3] ALL WIRES ARE 24GA.

[2] WIRES J1-50 TO J2-1 & J1-48 TO J2-2.
1. FOR SCHEMATIC SEE DWG. NO. E 8300-080.

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES	ZONE
-1		PL 8300 710	PRINTS 4 & 5	SHEETS 4, 5 & 6				

DIM IN INCHES TOLERANCES XXX = .010, XX = .03, X° = 30. BREAK ALL SHARP CORNERS & EDGES MACH SURFACES. DWG SIZE D.

TITLE: PRINT BOARD (A15) — P.C. BOARD ASSEMBLY

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

MODEL 8300 | CONTRACT NO | CODE IDENT 16067

RELEASE | CHECKER Wiener 9/1/6 | PURCHASING | DWG NO. D8300-710 | REV /

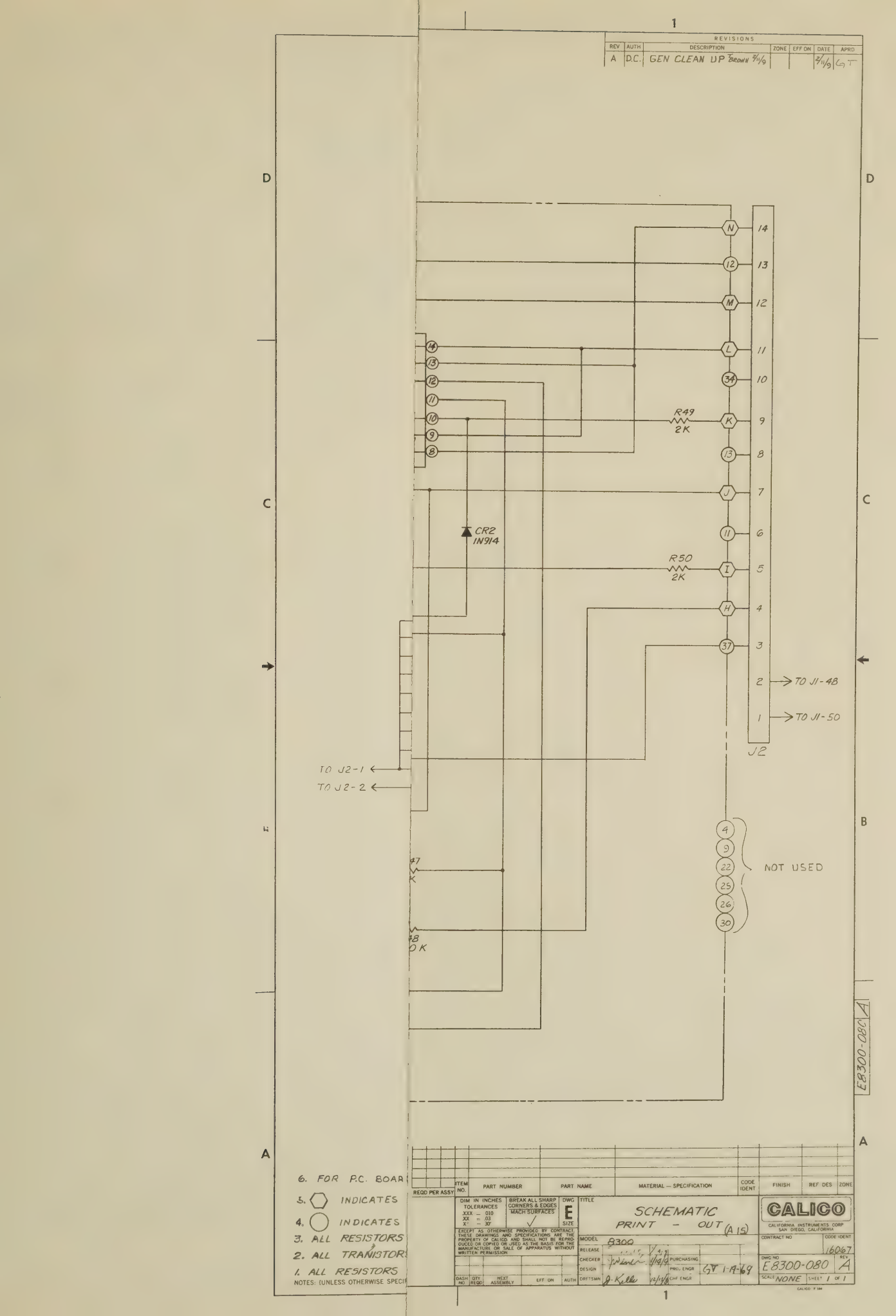
DESIGN | PROJ ENGR | SCALE 4/1 | SHEET 2 OF 6

DRFTSMN T.P. 1/5/6 | CHF ENGR

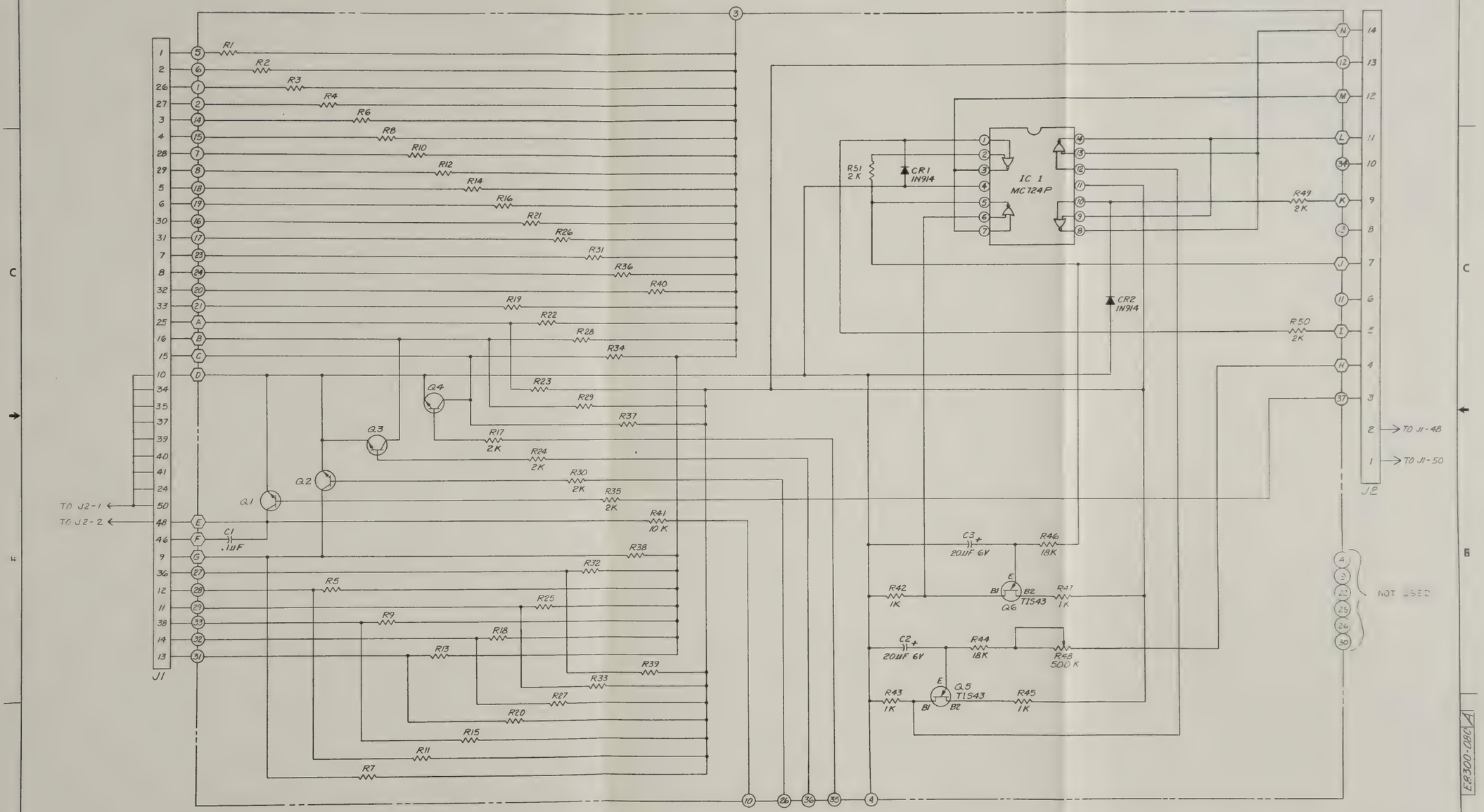
DASH NO | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

D8300-710 /


REVISIONS
REV | AUTH | DESCRIPTION | ZONE | EFF ON | DATE | APRD
A | D.C. | GEN CLEAN UP Brown 9/1/9 | | | 2/1/69 | GT
N
14
12
13
M
12
L
11
34
10
R49
2K
K
9
13
8
J
7
CR2
IN914
11
6
R50
2K
I
5
H
4
37
3
2
TO J1-48
1
TO J1-50
J2
TO J2-1
TO J2-2
4
9
22
25
26
30
NOT USED
E8300-080 A
6. FOR P.C. BOAR
5. ⬡ INDICATES
4. ◯ INDICATES
3. ALL RESISTORS
2. ALL TRANISTORS
1. ALL RESISTORS
NOTES: (UNLESS OTHERWISE SPECI
ITEM NO.
PART NUMBER
PART NAME
MATERIAL — SPECIFICATION
CODE IDENT
FINISH
REF DES
ZONE
REQD PER ASSY
DIM IN INCHES
TOLERANCES
XXX — .010
XX — .03
X — .1/2°
BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES
DWG SIZE E
EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED, COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION
DASH NO
QTY REQD
NEXT ASSEMBLY
EFF ON
AUTH
TITLE
SCHEMATIC
PRINT - OUT (A15)
CALICO
CALIFORNIA INSTRUMENTS CORP
SAN DIEGO, CALIFORNIA
MODEL 8300
RELEASE
CHECKER
DESIGN
DRFTSMN J. Kelly 12/1/8
PURCHASING
PROD. ENGR
CHF ENGR
GT 1-9-69
CONTRACT NO
CODE IDENT 16067
DWG NO E8300-080
REV A
SCALE NONE
SHEET 1 OF 1

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFT OR	DATE	APPR
A	D.C.	GEN CLEAN UP Brown 9/6			9/6/69	



6. FOR P.C. BOARD ASSY. SEE DWG. NO. 8300-710.
5. ⬡ INDICATES TIE POINT ON P.C. BOARD.
4. ◯ INDICATES ELCO CONTACTS ON P.C. BOARD.
3. ALL RESISTORS ARE 3.6K.
2. ALL TRANISTORS ARE 2N3566.
1. ALL RESISTORS ARE 1/4W-6%.

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
REQD PER ASSY							

DIM. IN INCHES TOLERANCES: XXX ± .010, XX ± .03, X ± .30
BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES √
DWG SIZE E

EXCEPT AS OTHERWISE PROVIDED IN CONTRACT THIS DRAWING AND SPECIFICATION IS CONFIDENTIAL PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

TITLE: SCHEMATIC PRINT - OUT (A15)

CALICO — CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA

MODEL 8300 — CONTRACT NO. — CODE IDENT 16087

RELEASE — DWG NO. E8300-080 REV A

CHECKER — PURCHASING — PROJ ENGR — CHF ENGR — GT 1-14-69

DESIGN — DRFTSMN D.K.Ellis 1/14/69

SCALE NONE SHEET 1 OF 1

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

E8300-080 A

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A15	8300-710	PRINT BOARD	16067		1
	-7	P.C. BOARD	16067	1-55044	2
					3
					4
A15C1	CK-104	CAPACITOR .1μf	71590	6-10129	5
A15C2	TE-1090	CAPACITOR 20μf 6V	56289	6-10345	6
A15C3	TE-1090	CAPACITOR 20μf 6V	56289	6-10345	7
					8
A15CR1	IN914	DIODE	JEDEC	3-10118	9
A15CR2	IN914	DIODE	JEDEC	3-10118	10
					11
A15IC1	MC 724P	I.C.	04713	3-30111	12
					13
A15R1	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	14
A15R2	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	15
A15R3	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	16
A15R4	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	17
A15R5	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	18
A15R6	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	19
A15R7	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	20
A15R8	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	21
A15R9	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	22
A15R10	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	23
A15R11	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	24
A15R12	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	25
A15R13	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	26
A15R14	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	27
A15R15	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	28
A15R16	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	29
A15R17	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	30
A15R18	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	31
A15R19	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	32
A15R20	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	33
A15R21	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	34
A15R22	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	35
A15R23	RC07GF326J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	36

MODEL 8300 — CALICO P/N 8300-710 — ASSY R.O. A15

TITLE PRINT BOARD — SHT 4 OF 6

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A15R24	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	37
A15R25	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	38
A15R26	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	39
A15R27	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	40
A15R28	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	41
A15R29	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	42
A15R30	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	43
A15R31	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	44
A15R32	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	45
A15R33	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	46
A15R34	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	47
A15R35	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	48
A15R36	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	49
A15R37	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	50
A15R38	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	51
A15R39	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	52
A15R40	RC07GF362J	RESISTOR 3.6K 1/4W 5%	JEDEC	5-10065	53
A15R41	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	54
A15R42	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	55
A15R43	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	56
A15R44	RC07GF183J	RESISTOR 18K 1/4W 5%	JEDEC	5-10082	57
A15R45	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	58
A15R46	RC07GF183J	RESISTOR 18K 1/4W 5%	JEDEC	5-10082	59
A15R47	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	60
A15R48	2387-500K	POT 500K	91637	5-70094	61
A15R49	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	62
A15R50	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	63
A15R51	RC07GF202J	RESISTOR 2K 1/4W 5%	JEDEC	5-10059	64
					65
	57-40140	RECEPTACLE	02660	4-10110	66
	57-40500	RECEPTACLE	02660	4-10024	67
	62-5204-40-12	GUIDE SOCKET	91662	2-40315	68
	02-019-372-5-200	ELCO PIN (UPPER TIER)	91662	2-40305	69
	02-018-332-5-200	ELCO PIN (LOWER TIER)	91662	2-40306	70
					71
					72

MODEL 8300 — CALICO P/N 8300-710 — ASSY R.O. A15

TITLE PRINT BOARD — SHT 5 OF 6

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | # PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	6-32 5/32 LG.	SCREW, PAN HEAD			73
	#6	WASHER, FLAT			74
	129515	BRACKET	73734		75
	1/4 ID	NYLON TUBING			76
	6-32 3/8 LG.	SCREW, PAN HEAD			77
	#6	WASHER, INT. STAR.			78
	833	CABLE CLAMP	83330		79
	6-32	HEX NUT			80
					81
A15Q1	2N3566	TRANSISTOR	02335	3-30091	82
A15Q2	2N3566	TRANSISTOR	02335	3-30091	83
A15Q3	2N3566	TRANSISTOR	02335	3-30091	84
A15Q4	2N3566	TRANSISTOR	02335	3-30091	85
A15Q5	TIS43	TRANSISTOR	01295	3-30131	86
A15Q6	TIS43	TRANSISTOR	01295	3-30131	87

MODEL 8300 | CALICO P/N 8300-710 | ASSY R.O. A15

TITLE PRINT BOARD | SHT 6 OF 6

ONE YEAR WARRANTY

CALIFORNIA INSTRUMENTS CORPORATION warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Excepted from this warranty are tubes, fuses, and batteries which carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS CORPORATION will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned to the Company freight prepaid, and when examination reveals that the fault has not occurred because of misuse or abnormal conditions of operation. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALICO will submit an estimate for such charges before commencing repair if so requested.

PROCEDURE FOR SERVICE

If a fault develops, notify CALICO or its local representative, giving full details of the difficulty, and including the model number and serial number. On receipt of this information, service data or shipping instructions will be furnished. If shipment is indicated, forward the instrument, freight prepaid, to the authorized repair station indicated in the instruction. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.

DAMAGE IN TRANSIT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. CALICO will advise the disposition to be made of the equipment and arrange for repair or replacement. Please include model number and serial number when referring to the instrument.

Smead®
UPC 10330
No. 153L
HASTINGS, MN

MINIMUM RECYCLED CONTENT
10% POST-CONSUMER